

37

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(54) 【発明の名称】 有機電界発光素子及び発光装置

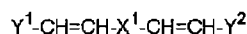
(57) 【要約】

【課題】 高い蛍光収率を有し、熱安定性にも優れた化合物を用いて、赤色の色純度が良く、高輝度かつ安定な赤色発光を有する有機電界発光素子を提供すること。

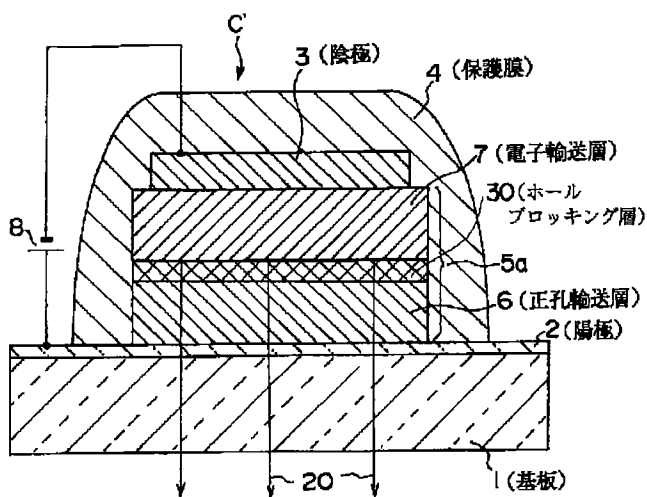
【解決手段】 ガラス基板1上に、ITO透明電極2、正孔輸送層6、電子輸送層7及び金属電極3がこの順に積層され、正孔輸送層6及び／又は電子輸送層7が下記一般式[I]で表されるアミノスチリル化合物の少なくとも1種を含んだ混合物層からなり、更に正孔輸送層6と電子輸送層7との間にホールブロッキング層30が設けられた有機電界発光素子。

【化55】

一般式 [I] :



[但し、前記一般式 [I] において、X¹はニトロ基等の置換基を有するフェニル基等のアリール基、Y¹及びY²はアミノフェニル基等を骨格に有する基である。]

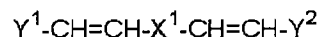


【特許請求の範囲】

【請求項 1】 発光領域を有する有機層が陽極と陰極との間に設けられている有機電界発光素子において、前記有機層の構成層のうちの少なくとも 1 層が、下記一般式 [I] で表されるアミノスチリル化合物の少なくとも 1 種を含んだ混合物層からなることを特徴とする有機電界発光素子。

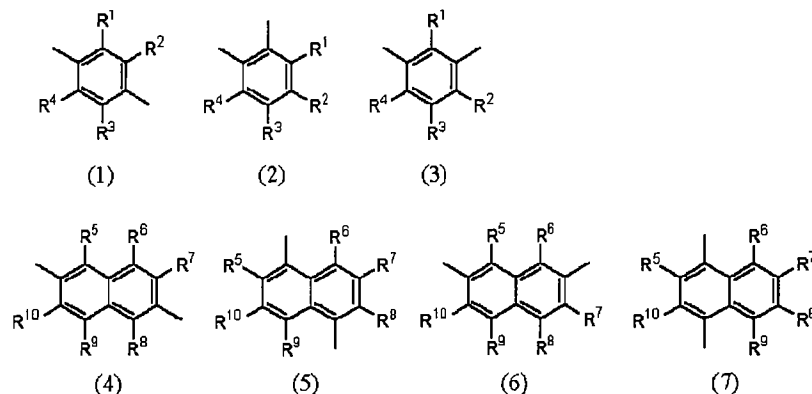
【化 1】

一般式 [I] :



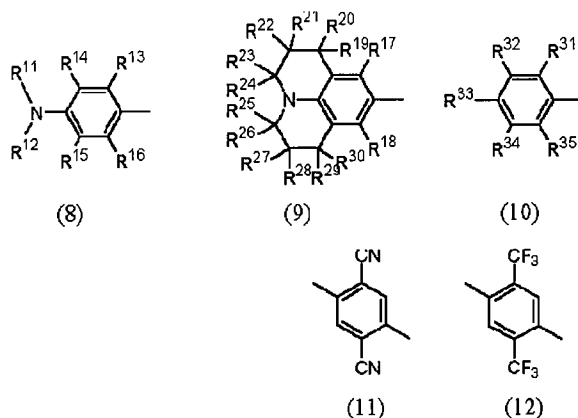
[但し、前記一般式 [I] において、 X^1 は下記一般式 (1) ~ (7) のいずれかで表される基であり

【化 2】



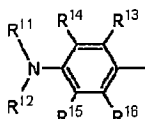
(但し、前記一般式 (1) ~ (3) において、 $R^1 \sim R^4$ のうち少なくとも一つはハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、その他は水素原子、アルキル基、アリール基、アルコキシ基、ハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、それらが同一であっても異なってもよく、また前記一般式 (4) ~ (7) において、 $R^5 \sim R^{10}$ のうち少なくとも一つはハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、その他は水素原子、アルキル基、アリール基、アルコキシ基、ハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、それらが同一であっても異なってもよい。)、また、 Y^1 は下記一般式 (8) 又は (9) で表される基であり、 Y^2 は下記一般式 (8)、(9) 又は (10) で表される基である。

【化 3】

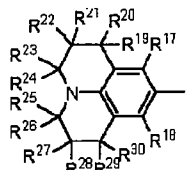


【化 4】

また、 Y^1 及び Y^2 は下記一般式 (8) 又は (9) で表される基である



(8)



(9)

(但し、前記一般式(8)及び(9)において、R¹¹及びR¹²は前記したものと同一であり、R¹³～R³⁰は前記したものと同一であるが、フルオロアルキル基の場合はトリフルオロメチル基である。)、請求項1に記載した有機電界発光素子。

【請求項3】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記電子輸送層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなる、請求項1に記載した有機電界発光素子。

【請求項4】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記ホール輸送層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなる、請求項1に記載した有機電界発光素子。

【請求項5】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホー

ル輸送層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなり、かつ前記電子輸送層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなる、請求項1に記載した有機電界発光素子。

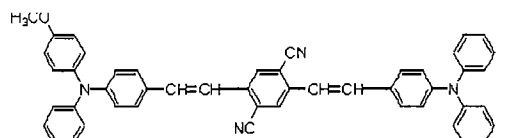
【請求項6】 前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記発光層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなる、請求項1に記載した有機電界発光素子。

【請求項7】 請求項1～6のいずれか1項に記載した有機電界発光素子を用いた発光装置。

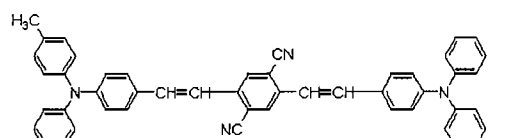
【請求項8】 ディスプレイデバイスとして構成された、請求項7に記載した発光装置。

【請求項9】 発光領域を有する有機層が陽極と陰極との間に設けられている有機電界発光素子において、前記有機層の構成層のうちの少なくとも1層が、下記構造式(15)－1～(15)－12、(16)－1～(16)－12、(17)－1～(17)－6、及び(18)－1～(18)－6で表されるアミノスチリル化合物の少なくとも1種を含んだ混合物層からなることを特徴とする有機電界発光素子。

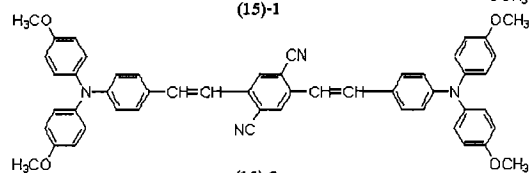
【化6】



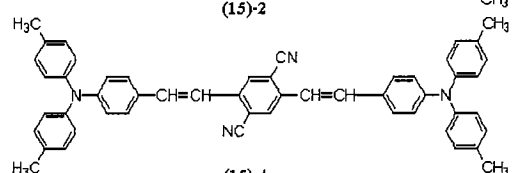
(15)-1



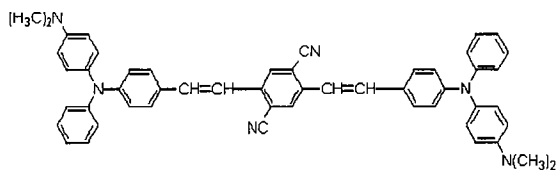
(15)-2



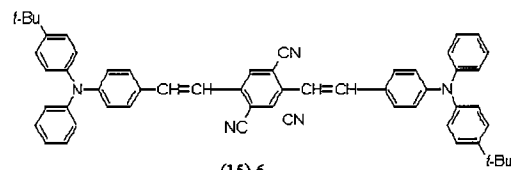
(15)-3



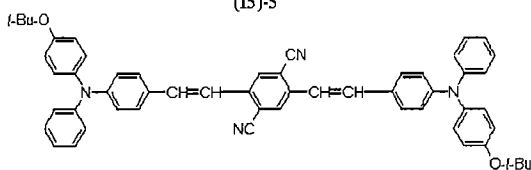
(15)-4



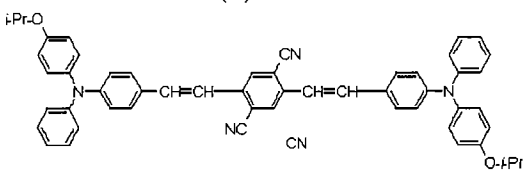
(15)-5



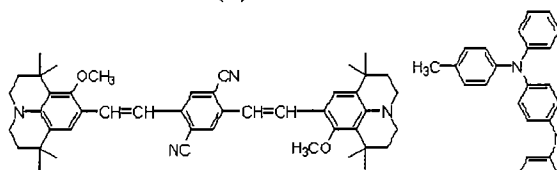
(15)-6



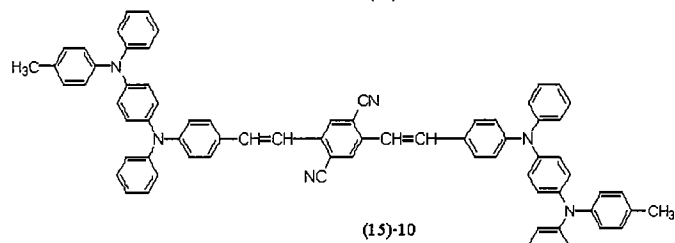
(15)-7



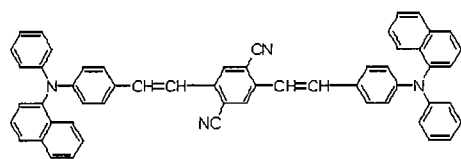
(15)-8



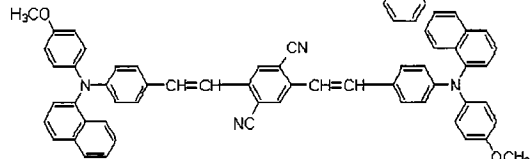
(15)-9



(15)-10

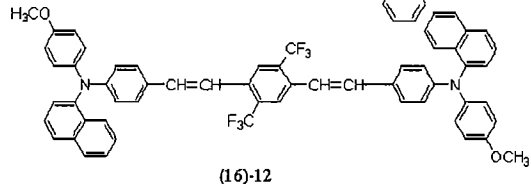
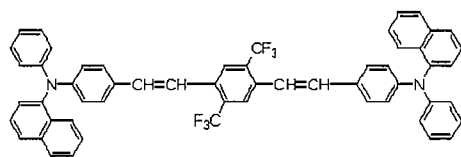
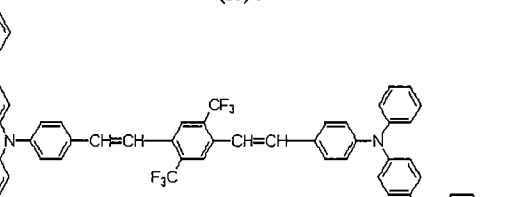
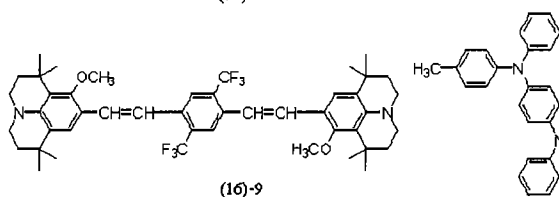
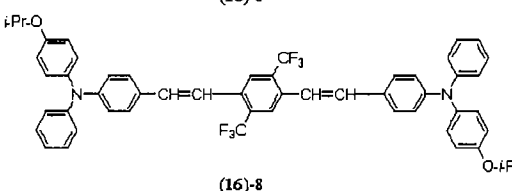
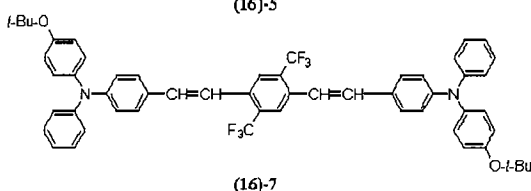
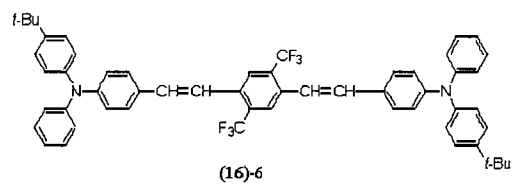
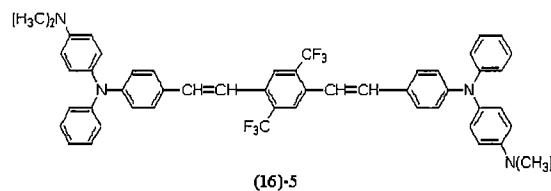
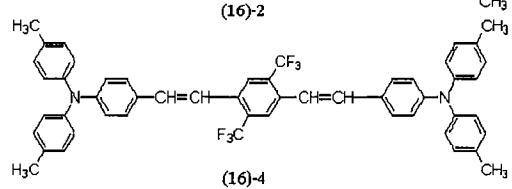
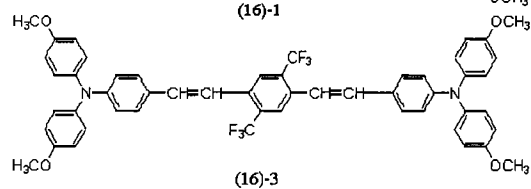
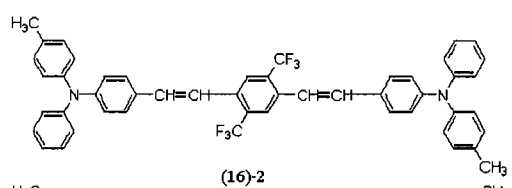
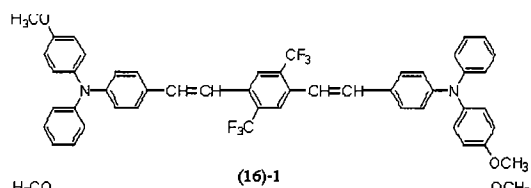


(15)-11

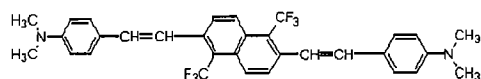
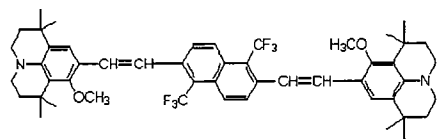
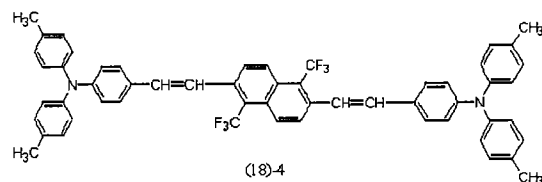
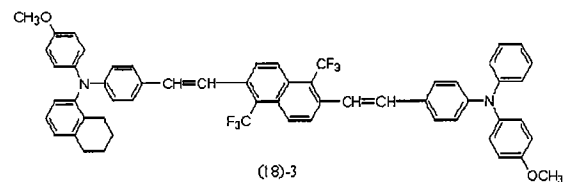
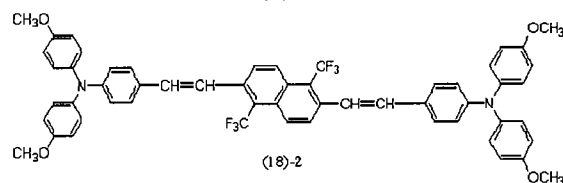
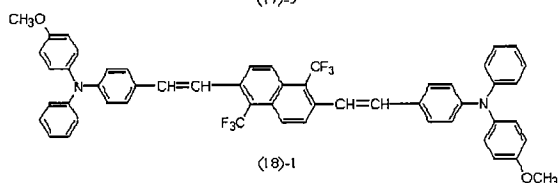
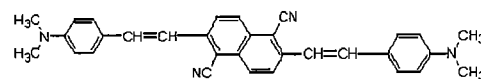
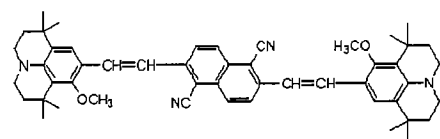
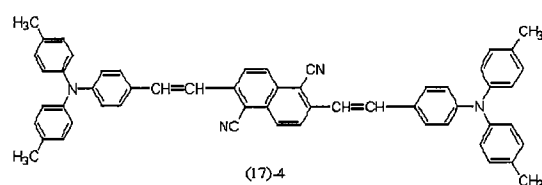
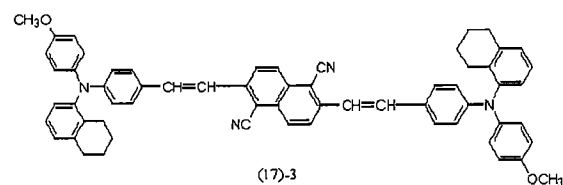
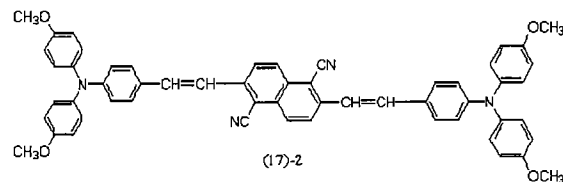
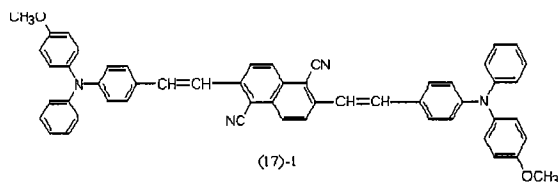


(15)-12

【化7】



【化 8】



【請求項 10】 前記有機層が、⁽¹⁸⁾⁻⁵ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも電子輸送層が、前記アミノスチリル化合物の少なくとも 1 種を含んだ前記混合物層からなる、請求項 9 に記載した有機電界発光素子。

【請求項 11】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくともホール輸送層が、前記アミノスチリル化合物の少なくとも 1 種を含んだ前記混合物層からなる、請求項 9 に記載した有機電界発光素子。

【請求項 12】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が、前記アミノスチリル化合物の少なくとも 1 種を含んだ前記混合物層からなり、かつ前記電子輸送層が、前記アミノスチリル化合物の少なくとも 1 種を含んだ前記混合物層からなる、請求項 9 に記載した有機電界発光素子。

【請求項 13】 前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも発光層が、前

混合物層からなる、⁽¹⁸⁾⁻⁶請求項 9 に記載した有機電界発光素子。

【請求項 14】 前記有機層の構成層のうちの前記少なくとも 1 層が、前記アミノスチリル化合物の少なくとも 1 種と、600nm 以上の範囲に発光極大を有する赤色発光色素とを含んだ前記混合物層からなる、請求項 9 に記載した有機電界発光素子。

【請求項 15】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機層の構成層のうちの前記少なくとも 1 層が少なくとも前記電子輸送層である、請求項 14 に記載した有機電界発光素子。

【請求項 16】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機層の構成層のうちの前記少なくとも 1 層が少なくとも前記ホール輸送層である、請求項 14 に記載した有機電界発光素子。

【請求項 17】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が、前記アミノスチリル化合物の少なくとも

色素とを含んだ前記混合物層からなり、かつ前記電子輸送層が、前記アミノスチリル化合物の少なくとも１種と、600nm以上の範囲に発光極大を有する赤色発光色素とを含んだ前記混合物層からなる、請求項９に記載した有機電界発光素子。

【請求項１８】 前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記発光層が、前記アミノスチリル化合物の少なくとも１種と、600nm以上の範囲に発光極大を有する赤色発光色素とを含んだ前記混合物層からなる、請求項９に記載した有機電界発光素子。

【請求項１９】 請求項９～１８のいずれか１項に記載した有機電界発光素子を用いた発光装置。

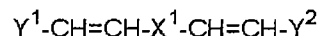
【請求項２０】 ディスプレイデバイスとして構成され

た、請求項１９に記載した発光装置。

【請求項２１】 発光領域を有する有機層が陽極と陰極との間に設けられている有機電界発光素子において、前記有機層の構成層のうちの少なくとも１層が、下記一般式〔Ⅰ〕で表されるアミノスチリル化合物の少なくとも１種を含んだ発光性の混合物層からなり、かつ前記発光性の混合物層の陰極側にホールブロッキング層が存在することを特徴とする有機電界発光素子。

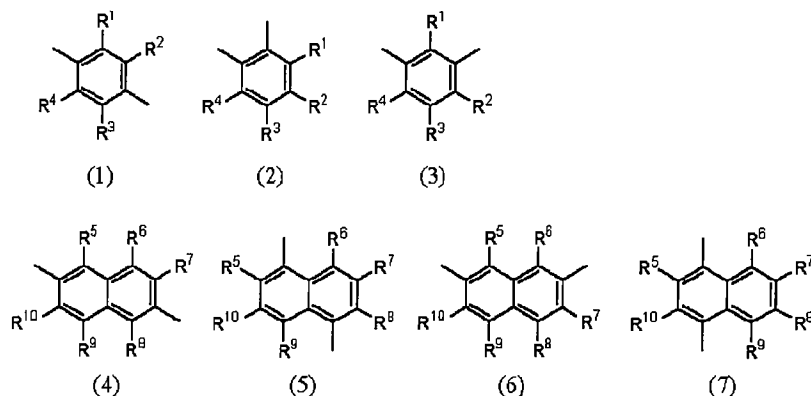
【化９】

一般式〔Ⅰ〕：



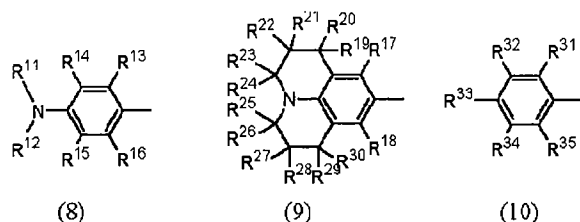
〔但し、前記一般式〔Ⅰ〕において、 X^1 は下記一般式（１）～（７）のいずれかで表される基であり

【化１０】



（但し、前記一般式（１）～（３）において、 $R^1 \sim R^4$ のうち少なくとも一つはハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、その他は水素原子、アルキル基、アリール基、アルコキシ基、ハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、それらが同一であっても異なってもよく、また前記一般式（４）～（７）において、 $R^5 \sim R^{10}$ のうち少なくとも一つはハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、その他は水素原子、アルキル基、アリール基、アルコキシ基、ハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、それらが同一であっても異なってもよい。）また、 Y^1 は下記一般式（８）又は（９）で表される基であり、 Y^2 は下記一般式（８）、（９）又は（１０）で表される基である。

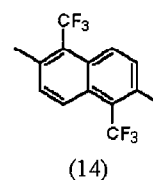
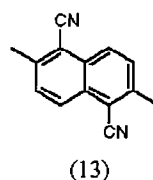
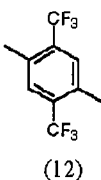
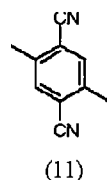
【化１１】



（但し、前記一般式（８）～（１０）において、 R^{11} 及び R^{12} は水素原子、置換基を有してもよいアルキル基及び置換基を有してもよいアリール基から選ばれた基であり、それらが同一であっても異なってもよく、また $R^{13} \sim R^{35}$ は水素原子、置換基を有してもよいアルキル基、置換基を有してもよいアリール基、置換基を有してもよいアルコキシ基、ハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、それらが同一であっても異なってもよい。）

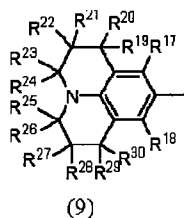
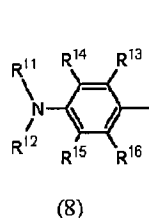
【請求項２２】 前記一般式〔Ⅰ〕において、 X^1 は下記構造式（１１）～（１４）のいずれかで表される基であり、

【化１２】



また、Y¹及びY²は下記一般式（８）又は（９）で表される基である

【化１３】



（但し、前記一般式（８）及び（９）において、R¹¹及びR¹²は前記したものと同じであり、R¹³～R³⁰は前記したものと同じであるが、フルオロアルキル基の場合はトリフルオロメチル基である。）、請求項２１に記載した有機電界発光素子。

【請求項２３】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記電子輸送層が、前記一般式〔Ⅰ〕で表されるアミノスチリル化合物の少なくとも１種を含んだ前記発光性の混合物層からなる、請求項２１に記載した有機電界発光素子。

【請求項２４】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記ホール輸送層が、前記一般式〔Ⅰ〕で表されるアミノスチリル化合物の少なくとも１種を含んだ前記発光性の混合物層からなる、請求項２１に記載した有機電界発光素子。

【請求項２５】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が、前記一般式〔Ⅰ〕で表されるアミノスチ

リル化合物の少なくとも１種を含んだ前記発光性の混合物層からなり、前記電子輸送層が、前記一般式〔Ⅰ〕で表されるアミノスチリル化合物の少なくとも１種を含んだ前記発光性の混合物層からなり、かつこの電子輸送性の発光性の混合物層の陰極側に前記ホールブロッキング層が存在する、請求項２１に記載した有機電界発光素子。

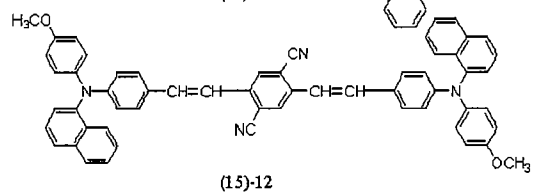
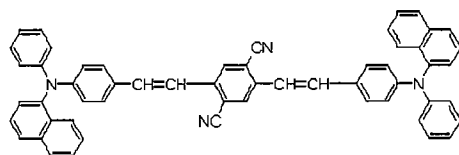
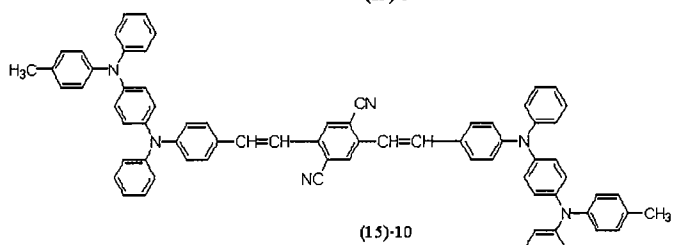
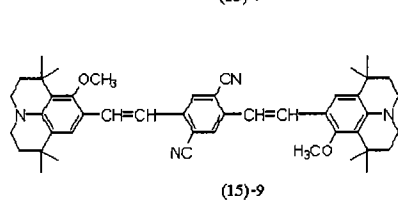
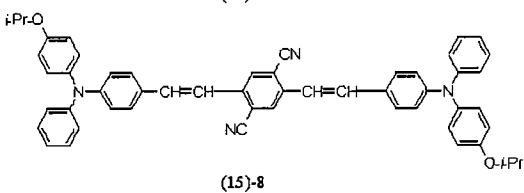
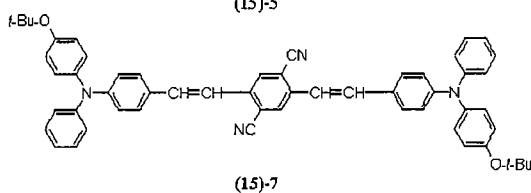
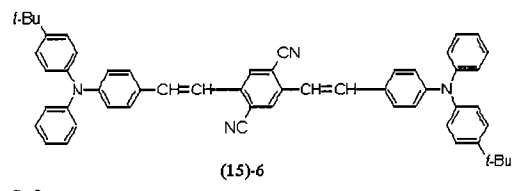
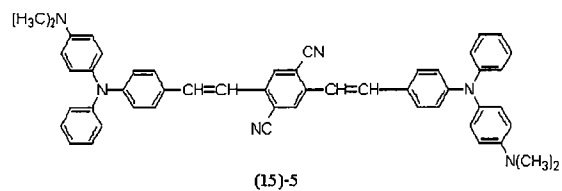
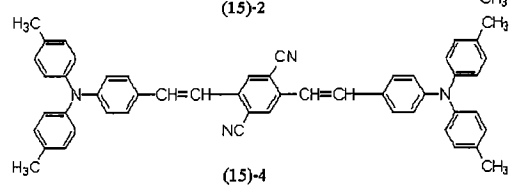
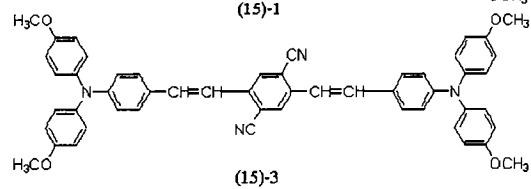
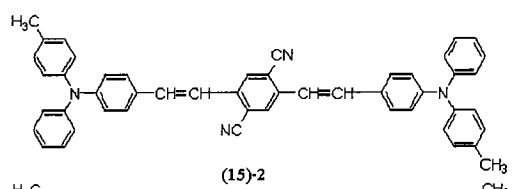
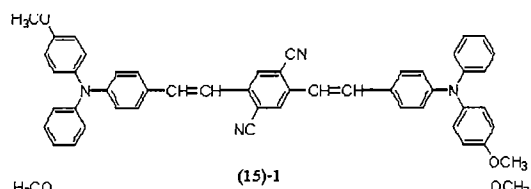
【請求項２６】 前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記発光層が、前記一般式〔Ⅰ〕で表されるアミノスチリル化合物の少なくとも１種を含んだ前記発光性の混合物層からなる、請求項２１に記載した有機電界発光素子。

【請求項２７】 請求項２１～２６のいずれか１項に記載した有機電界発光素子を用いた発光装置。

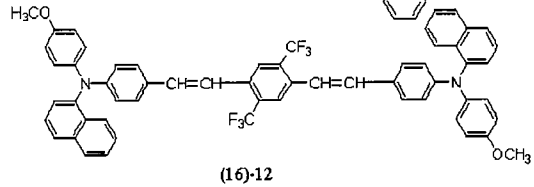
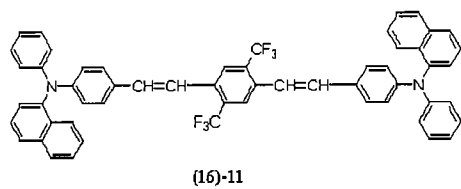
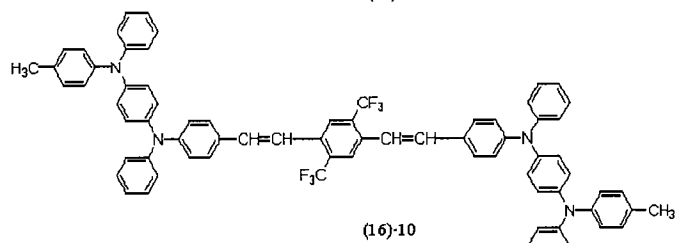
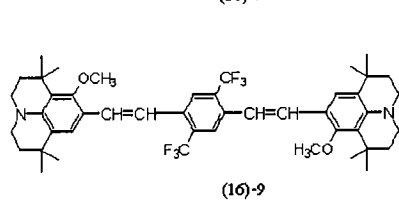
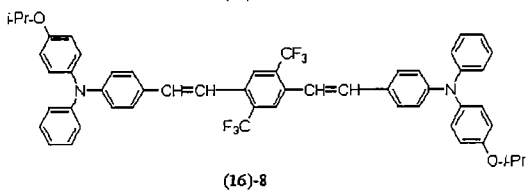
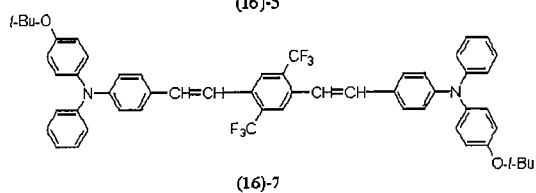
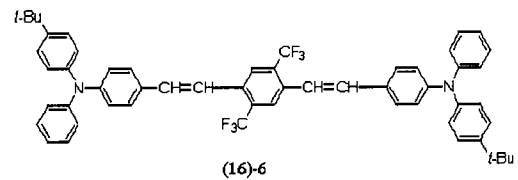
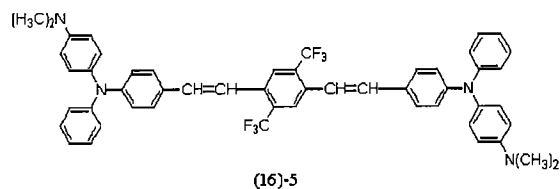
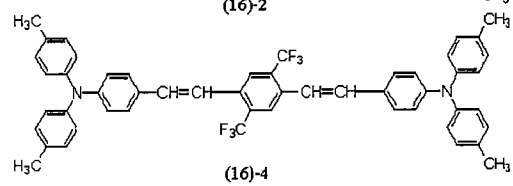
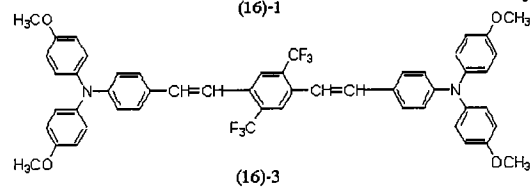
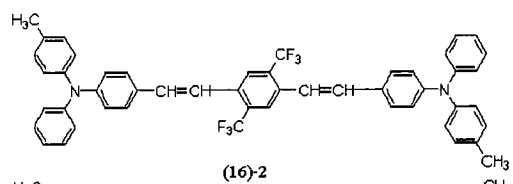
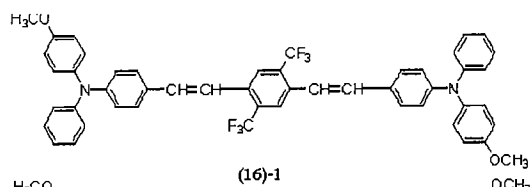
【請求項２８】 ディスプレイデバイスとして構成された、請求項２７に記載した発光装置。

【請求項２９】 発光領域を有する有機層が陽極と陰極との間に設けられている有機電界発光素子において、前記有機層の構成層のうちの少なくとも１層が、下記構造式（１５）－１～（１５）－１２、（１６）－１～（１６）－１２、（１７）－１～（１７）－６、及び（１８）－１～（１８）－６で表されるアミノスチリル化合物の少なくとも１種を含んだ発光性の混合物層からなり、かつ前記発光性の混合物層の陰極側にホールブロッキング層が存在することを特徴とする有機電界発光素子。

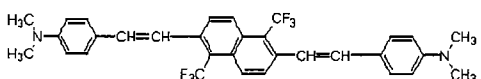
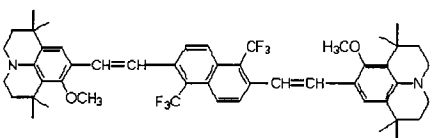
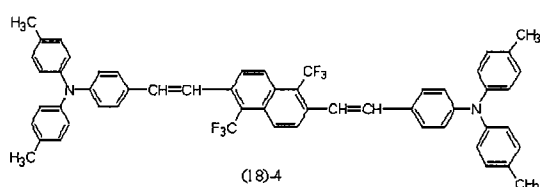
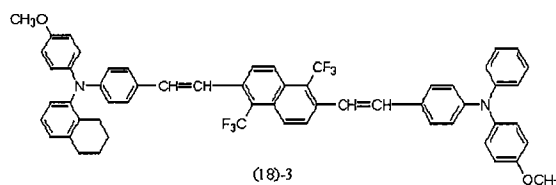
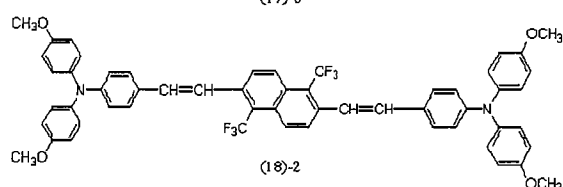
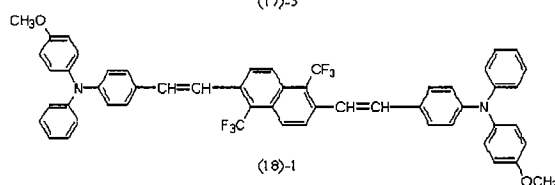
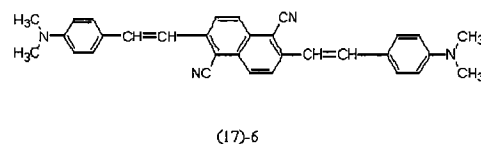
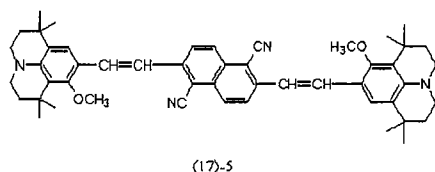
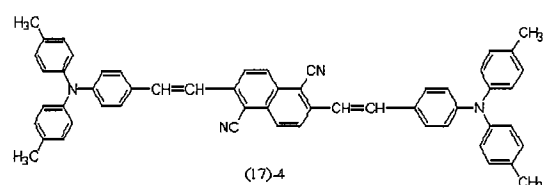
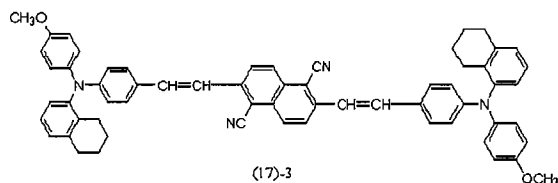
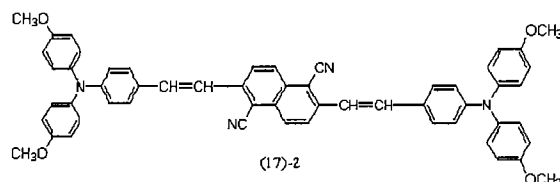
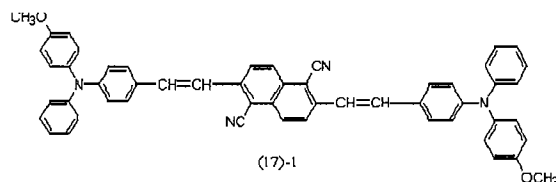
【化１４】



【化 15】



【化 16】



【請求項 30】 前記有機層が、⁽¹⁸⁾⁻⁵ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも電子輸送層が、前記アミノスチリル化合物の少なくとも 1 種を含んだ前記発光性の混合物層からなる、請求項 29 に記載した有機電界発光素子。

【請求項 31】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくともホール輸送層が、前記アミノスチリル化合物の少なくとも 1 種を含んだ前記発光性の混合物層からなる、請求項 29 に記載した有機電界発光素子。

【請求項 32】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が、前記アミノスチリル化合物の少なくとも 1 種を含んだ前記発光性の混合物層からなり、前記電子輸送層が、前記アミノスチリル化合物の少なくとも 1 種を含んだ前記発光性の混合物層からなり、かつこの電子輸送性の発光性の混合物層の陰極側に前記ホールブロッキング層が存在する、請求項 29 に記載した有機電界発

【請求項 33】 前記有機層が、⁽¹⁸⁾⁻⁶ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも発光層が、前記アミノスチリル化合物の少なくとも 1 種を含んだ前記発光性の混合物層からなる、請求項 29 に記載した有機電界発光素子。

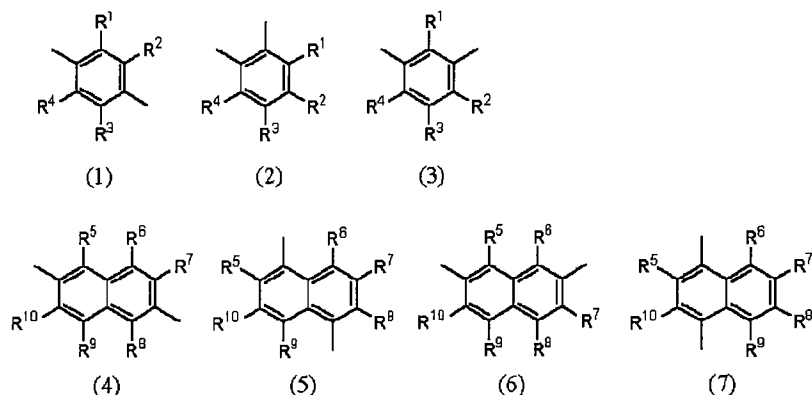
【請求項 34】 前記有機層の構成層のうちの前記少なくとも 1 層が、前記アミノスチリル化合物の少なくとも 1 種と、600nm 以上の範囲に発光極大を有する赤色発光色素とを含んだ前記発光性の混合物層からなる、請求項 29 に記載した有機電界発光素子。

【請求項 35】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機層の構成層のうちの前記少なくとも 1 層が少なくとも前記電子輸送層である、請求項 34 に記載した有機電界発光素子。

【請求項 36】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機層の構成層のうちの前記少なくとも 1 層が少なくとも前記ホール輸送層である、請求項 34 に記載した有機電

【請求項 3 7】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が、前記アミノスチリル化合物の少なくとも 1 種と、600nm 以上の範囲に発光極大を有する赤色発光色素とを含んだ前記発光性の混合物層からなり、前記電子輸送層が、前記アミノスチリル化合物の少なくとも 1 種と、600nm 以上の範囲に発光極大を有する赤色発光色素とを含んだ前記発光性の混合物層からなり、かつこの電子輸送性の発光性の混合物層の陰極側に前記ホールブロッキング層が存在する、請求項 2 9 に記載した有機電界発光素子。

【請求項 3 8】 前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記発光層が、前記アミノスチリル化合物の少なくとも 1 種と、600nm 以上の範囲に発光極大を有する赤色発光色素とを含んだ前記発光性の混合物層からなる、請求項 2 9 に記載した有機電界発光素子。



(但し、前記一般式 (1) ~ (3) において、 $R^1 \sim R^4$ のうち少なくとも一つはハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、その他は水素原子、アルキル基、アリール基、アルコキシ基、ハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、それらが同一であっても異なってもよく、また前記一般式 (4) ~ (7) において、 $R^5 \sim R^{10}$ のうち少なくとも一つはハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、その他は水素原子、アルキル基、アリール基、アルコキシ基、ハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、それらが同一であっても異なってもよい。)、また、 Y^1 は下記一般式 (8) 又は (9) で表される基であり、 Y^2 は下記一般式 (8)、(9) 又は (10) で表される基である。

【化 1 9】

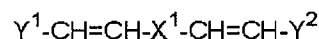
【請求項 3 9】 請求項 2 9 ~ 3 8 のいずれか 1 項に記載した有機電界発光素子を用いた発光装置。

【請求項 4 0】 ディスプレイデバイスとして構成された、請求項 3 9 に記載した発光装置。

【請求項 4 1】 発光領域を有する有機層が陽極と陰極との間に設けられている有機電界発光素子において、前記有機層の構成層のうちの少なくとも 1 層が、下記一般式 [I] で表されるアミノスチリル化合物で構成されたアミノスチリル化合物層からなり、かつ前記アミノスチリル化合物層の陰極側にホールブロッキング層が存在することを特徴とする有機電界発光素子。

【化 1 7】

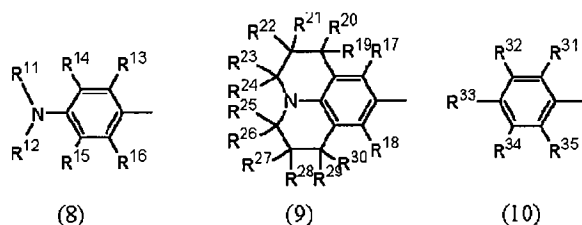
一般式 [I] :



[但し、前記一般式 [I] において、 X^1 は下記一般式

(1) ~ (7) のいずれかで表される基であり

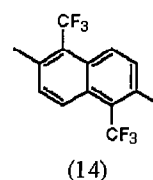
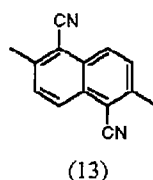
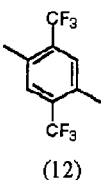
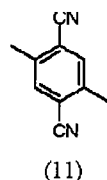
【化 1 8】



(但し、前記一般式 (8) ~ (10) において、 R^{11} 及び R^{12} は水素原子、置換基を有してもよいアルキル基及び置換基を有してもよいアリール基から選ばれた基であり、それらが同一であっても異なってもよく、また $R^{13} \sim R^{35}$ は水素原子、置換基を有してもよいアルキル基、置換基を有してもよいアリール基、置換基を有してもよいアルコキシ基、ハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、それらが同一であっても異なってもよい。)]

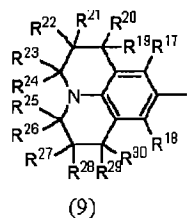
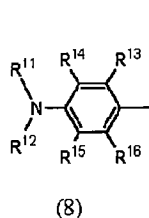
【請求項 4 2】 前記一般式 [I] において、 X^1 は下記構造式 (11) ~ (14) のいずれかで表される基であり、

【化 2 0】



また、Y¹及びY²は下記一般式（８）又は（９）で表される基である

【化２１】



（但し、前記一般式（８）及び（９）において、R¹¹及びR¹²は前記したものと同一であり、R¹³～R³⁰は前記したものと同一であるが、フルオロアルキル基の場合はトリフルオロメチル基である。）、請求項４１に記載した有機電界発光素子。

【請求項４３】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記電子輸送層が前記アミノスチリル化合物層からなる、請求項４１に記載した有機電界発光素子。

【請求項４４】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記ホール輸送層が前記アミノスチリル化合物層からなる、請求項４１に記載した有機電界発光素子。

【請求項４５】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホ

ール輸送層が前記アミノスチリル化合物層からなり、前記電子輸送層が前記アミノスチリル化合物層からなり、かつこの電子輸送性のアミノスチリル化合物層の陰極側に前記ホールブロッキング層が存在する、請求項４１に記載した有機電界発光素子。

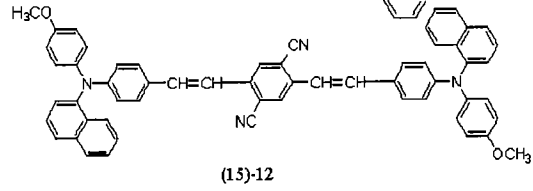
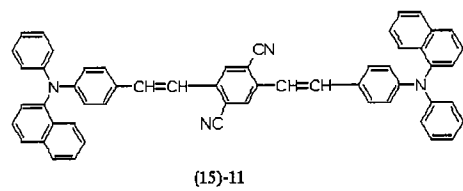
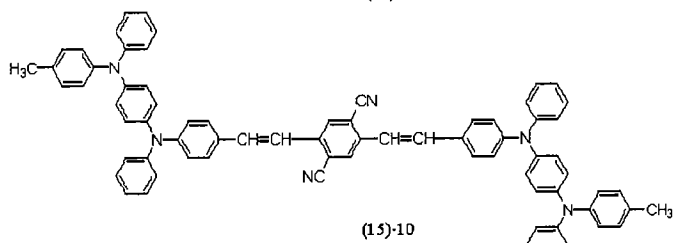
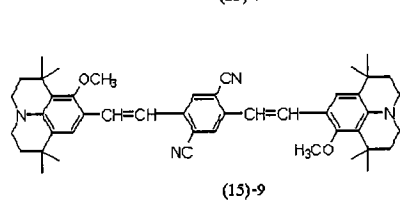
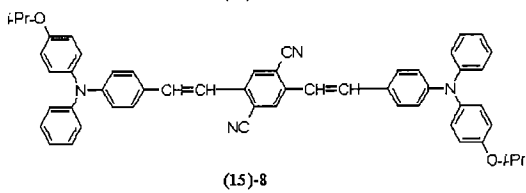
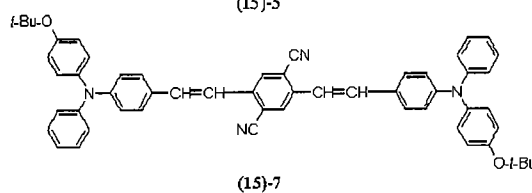
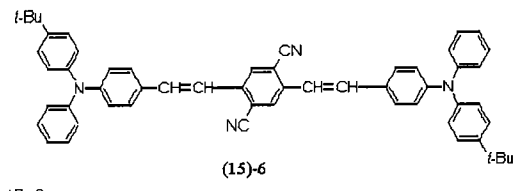
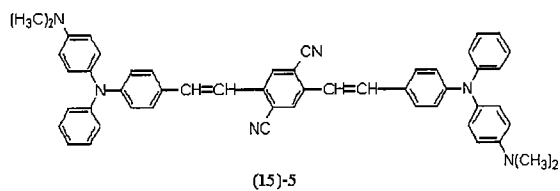
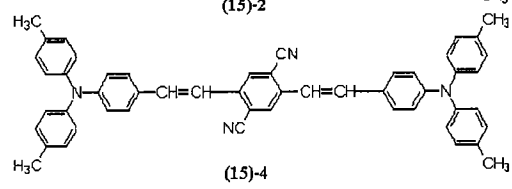
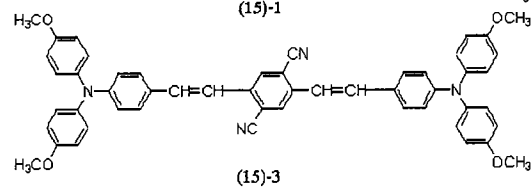
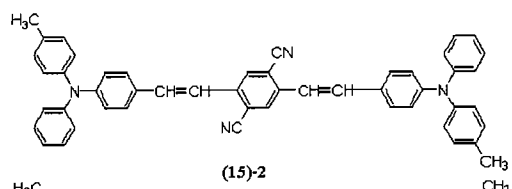
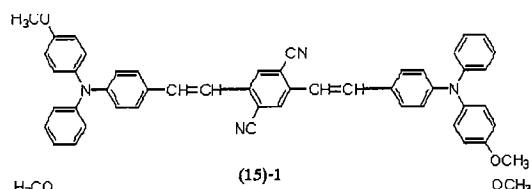
【請求項４６】 前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記発光層が前記アミノスチリル化合物層からなる、請求項４１に記載した有機電界発光素子。

【請求項４７】 請求項４１～４６のいずれか１項に記載した有機電界発光素子を用いた発光装置。

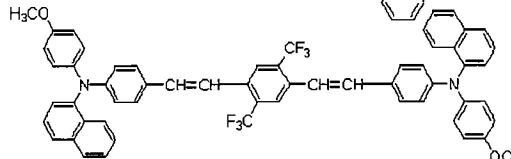
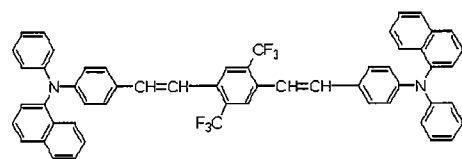
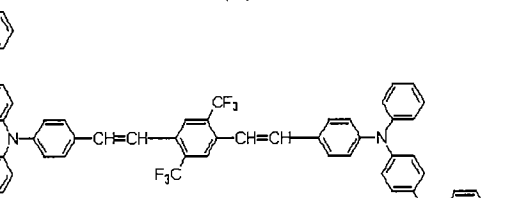
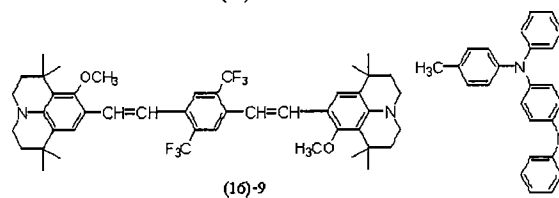
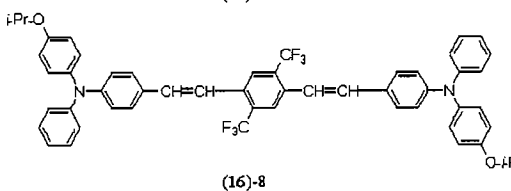
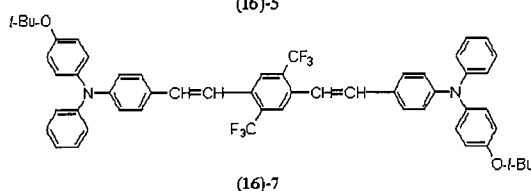
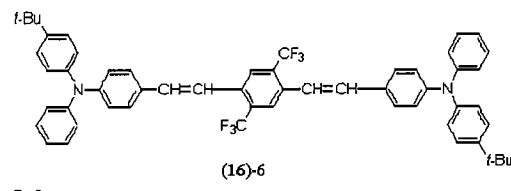
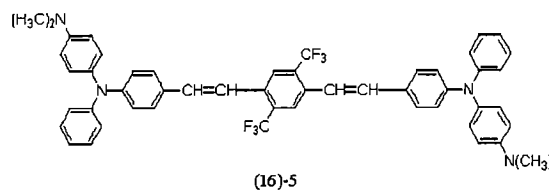
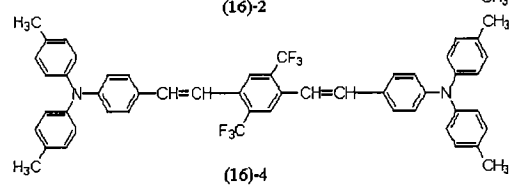
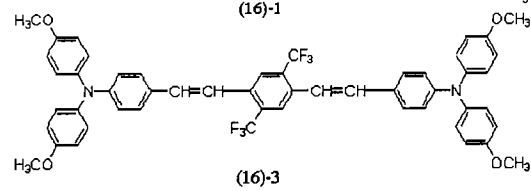
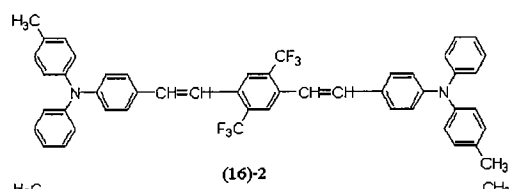
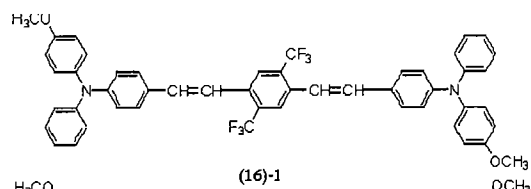
【請求項４８】 ディスプレイデバイスとして構成された、請求項４７に記載した発光装置。

【請求項４９】 発光領域を有する有機層が陽極と陰極との間に設けられている有機電界発光素子において、前記有機層の構成層のうちの少なくとも１層が、下記構造式（１５）－１～（１５）－１２、（１６）－１～（１６）－１２、（１７）－１～（１７）－６、及び（１８）－１～（１８）－６で表されるアミノスチリル化合物から選ばれたアミノスチリル化合物で構成されたアミノスチリル化合物層からなり、かつ前記アミノスチリル化合物層の陰極側にホールブロッキング層が存在することを特徴とする有機電界発光素子。

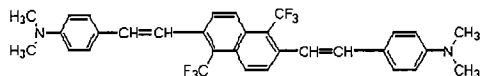
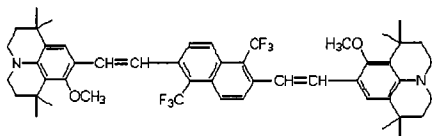
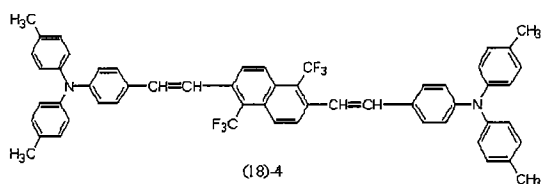
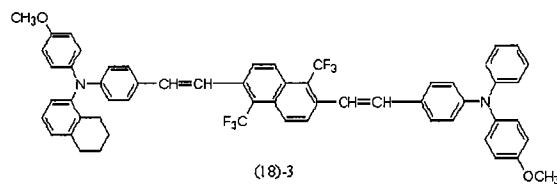
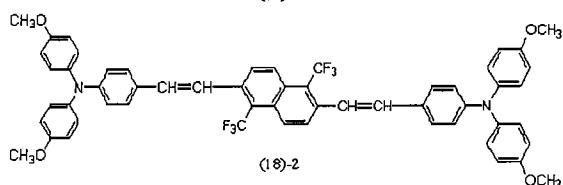
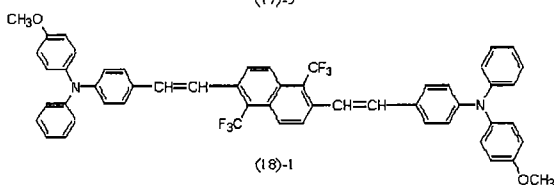
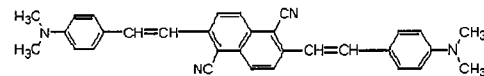
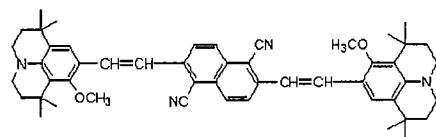
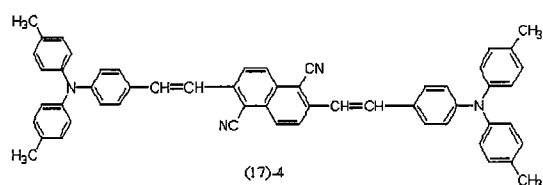
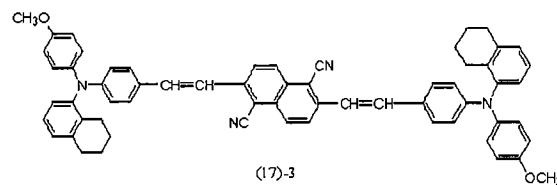
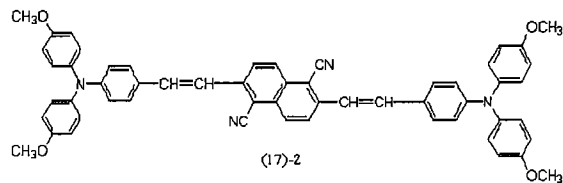
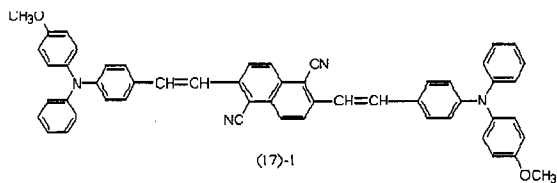
【化２２】



【化 2 3】



【化 2 4】



【請求項 5 0】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも電子輸送層が前記アミノスチリル化合物層からなる、請求項 4 9 に記載した有機電界発光素子。

【請求項 5 1】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくともホール輸送層が前記アミノスチリル化合物層からなる、請求項 4 9 に記載した有機電界発光素子。

【請求項 5 2】 前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が前記アミノスチリル化合物層からなり、前記電子輸送層が前記アミノスチリル化合物層からなり、かつこの電子輸送性のアミノスチリル化合物層の陰極側に前記ホールブロッキング層が存在する、請求項 4 9 に記載した有機電界発光素子。

【請求項 5 3】 前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも発光層が前記

た有機電界発光素子。

【請求項 5 4】 請求項 4 9～5 3 のいずれか 1 項に記載した有機電界発光素子を用いた発光装置。

【請求項 5 5】 ディスプレイデバイスとして構成された、請求項 5 4 に記載した発光装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、発光領域を有する有機層が陽極と陰極との間に設けられている有機電界発光素子（有機 EL 素子）、及びこれを用いたディスプレイデバイス等の発光装置に関するものである。

【0002】

【従来の技術】軽量で高効率のフラットパネルディスプレイが、例えばコンピュータやテレビジョンの画面表示用として盛んに研究、開発されている。

【0003】まず、ブラウン管（CRT）は、輝度が高く、色再現性が良いため、現在ディスプレイとして最も多く使われているが、嵩高く、重く、また消費電力も高いという問題がある。

【0004】また、軽量で高効率のフラットパネルディ

ディスプレイが商品化されているが、液晶ディスプレイは視野角が狭く、また自発光でないために、周囲が暗い環境下ではバックライトの消費電力が大きいことや、今後実用化が期待されている高精細度の高速ビデオ信号に対して十分な応答性能を有しない等の問題点がある。特に、大画面サイズのディスプレイを製造することは困難であり、そのコストが高い等の課題もある。

【0005】これに対する代替として、発光ダイオードを用いたディスプレイの可能性があるが、やはり製造コストが高く、また、1つの基板上に発光ダイオードのマトリックス構造を形成することが難しい等の問題があり、ブラウン管に取って代わる低価格のディスプレイ候補としては、実用化までの課題が大きい。

【0006】これらの諸課題を解決する可能性のあるフラットパネルディスプレイとして、最近、有機発光材料を用いた有機電界発光素子（有機EL素子）が注目されている。即ち、発光材料として有機化合物を用いることにより、自発光で、応答速度が高速であり、視野角依存性の無いフラットパネルディスプレイの実現が期待されている。

【0007】有機電界発光素子の構成は、透光性の正極と金属陰極との間に、電流の注入によって発光する発光材料を含む有機薄膜を形成したものである。C. W. Tang, S. A. VanSlyke等は Applied Physics Letters第51巻12号913～915頁（1987年）掲載の研究報告において、有機薄膜を正孔輸送性材料からなる薄膜と電子輸送性材料からなる薄膜との2層構造として、各々の電極から有機膜中に注入されたホールと電子が再結合することにより発光する素子構造を開発した（シングルヘテロ構造の有機EL素子）。

【0008】この素子構造では、正孔輸送材料または電子輸送材料のいずれかが発光材料を兼ねており、発光は発光材料の基底状態と励起状態のエネルギーギャップに対応した波長帯で起きる。このような2層構造とすることにより、大幅な駆動電圧の低減、発光効率の改善が行われた。

【0009】その後、C. Adachi、S. Tokita、T. Tsutsui、S. Saito等の Japanese Journal of Applied Physics第27巻2号L269～L271頁（1988年）掲載の研究報告に記載されているように、正孔輸送材料、発光材料、電子輸送材料の3層構造（ダブルヘテロ構造の有機EL素子）が開発され、更に、C. W. Tang, S. A. VanSlyke, C. H. Chen等の Journal of Applied Physics 第65巻9号3610～3616頁（1989年）掲載の研究報告に記載されているように、電子輸送材料中に発光材料を含ませた素子構造などが開発された。これらの研究により、低電圧で、高輝度の発光の可能性が検証され、近年、研究開発が非常に活発に行われている。

性から、理論的には分子構造を変化させることによって発光色を任意に変えることができるという利点があると言える。従って、分子設計を施すことにより、フルカラーディスプレイに必要な色純度の良いR（赤）、G（緑）、B（青）の3色を揃えることは、無機物を用いた薄膜EL素子と比べて容易であると言える。

【0011】

【発明が解決しようとする課題】しかしながら、実際には有機電界発光素子においても、解決しなければならない問題がある。安定した高輝度の赤色発光素子の開発は難しく、現在報告されている電子輸送材料として、トリス（8-キノリノール）アルミニウム（以下、Alq3と略称。）にDCM〔4-ジシアノメチレン-6-（p-ジメチルアミノスチリル）-2-メチル-4H-ピラン〕をドープした赤色発光の例（Chem. Funct. Dyes, Proc. Int. Symp., 2nd P.536(1993)）等があるが、輝度、信頼性ともにディスプレイ材料としては満足のいくものではない。

【0012】また、T. Tsutsui, D. U. Kim が Inorganic and Organic electroluminescence 会議（1996、Berlin）で報告したBSB-BCNは、1000cd/m²以上の高い輝度を実現しているが、フルカラーに対応する赤色としての色度が完全なものとは言えない。

【0013】さらに高輝度で安定かつ色純度の高い赤色発光素子の実現が、望まれているのが現状である。

【0014】また、特開平7-188649号（特願平6-148798号）においては、特定のジスチリル化合物を有機電界発光材料とすることを提案しているが、目的の発光色が青色であり、赤色用ではない。

【0015】本発明の目的は、高い蛍光収率を有し、熱安定性にも優れた化合物を用いて、赤色の色純度が良く、高輝度かつ安定な赤色発光を有する有機電界発光素子を提供することにある。

【0016】本発明の他の目的は、本来高い量子収率を有する化合物を含有する有機電界発光素子において、発光層でのホールと電子の再結合を促進し、さらに高輝度かつ高効率な発光を呈する有機電界発光素子を提供することにある。

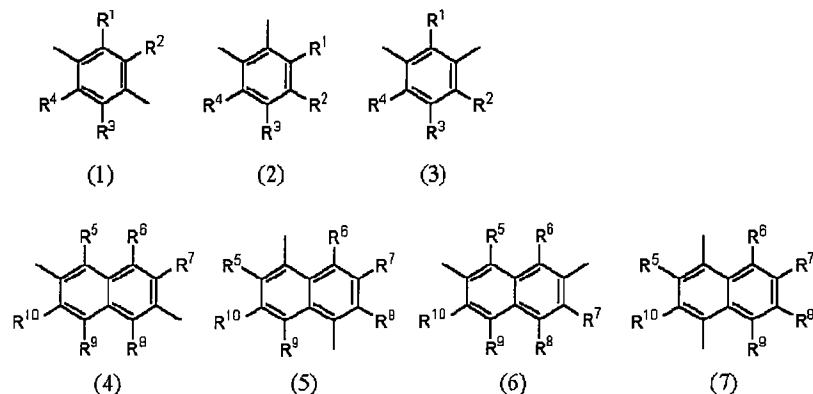
【0017】

【課題を解決するための手段】本発明者は、上記課題を解決するために鋭意検討した結果、特に、特定のアミノスチリル化合物と、これに効率良くエネルギーを伝達することが可能な材料とから発光領域を構成した有機電界発光素子を作製すれば、高輝度、高信頼性の赤色発光素子を提供できることを見出し、本発明に到達したものである。

【0018】即ち、本発明は、発光領域を有する有機層が陽極と陰極との間に設けられ、電流の注入によって発光する有機物質を構成要素として含む有機電界発光素子

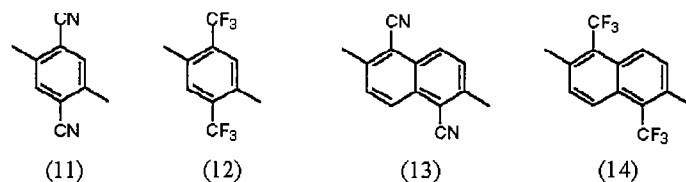
が、下記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種（1種であってよいが、2種又はそれ以上であってもよい。）を含んだ混合物層からなることを特徴とする有機電界発光素子（以下、本発明の第1の有機EL素子と称することがある。）に係るものである。

【0019】



（但し、前記一般式（1）～（3）において、R¹～R⁴のうち少なくとも一つ（例えば一つ又は二つ）はハロゲン原子（フッ素原子、塩素原子、臭素原子等：以下、同様）、ニトロ基、シアノ基及びフルオロアルキル基（トリフルオロメチル基等：以下、同様）から選ばれた基であり、その他は水素原子、アルキル基、アリール基、アルコキシ基、ハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、それらが同一であっても異なってもよく、また前記一般式（4）～（7）において、R⁵～R¹⁰のうち少なくとも一つ（例えば一つ又は二つ）はハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、その他は水素原子、アルキル基、アリール基、アルコキシ基、ハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、それらが同一であっても異なってもよい。）また、Y¹は下記一般式（8）又は（9）で表される基であり、Y²は下記一般式（8）、（9）又は（10）で表される基である。

【化27】

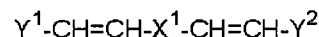


また、Y¹及びY²は下記一般式（8）又は（9）で表される基であってよい（以下、同様）。

【化29】

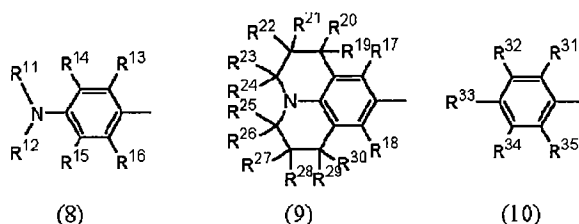
【化25】

一般式〔I〕：



〔但し、前記一般式〔I〕において、X¹は下記一般式（1）～（7）のいずれかで表される基であり

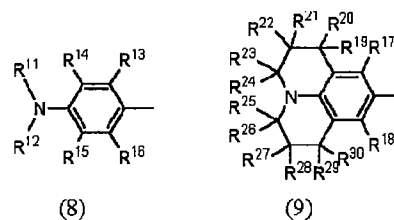
【化26】



（但し、前記一般式（8）～（10）において、R¹¹及びR¹²は水素原子、置換基を有してもよいアルキル基及び置換基を有してもよいアリール基から選ばれた基であり、それらが同一であっても異なってもよく、またR¹³～R³⁵は水素原子、置換基を有してもよいアルキル基、置換基を有してもよいアリール基、置換基を有してもよいアルコキシ基、ハロゲン原子、ニトロ基、シアノ基及びフルオロアルキル基から選ばれた基であり、それらが同一であっても異なってもよい。）

【0020】前記一般式〔I〕において、X¹は下記構造式（11）～（14）のいずれかで表される基であり、

【化28】



びR¹²は前記したものと同一であり、R¹³〜R³⁰は前記したものと同一であるが、フルオロアルキル基の場合はトリフルオロメチル基である。)

【0021】本発明の第1の有機EL素子において、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記電子輸送層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなっておりよい。

【0022】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記ホール輸送層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなっておりよい。

【0023】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなり、かつ前記電子輸送層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなっておりよい。

【0024】また、前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記発光層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなっておりよい。

【0025】本発明において、前記アミノスチリル化合物を含む混合物層を形成するのに使用可能な材料としては、前記アミノスチリル化合物の他に、ホール輸送材料(例えば、芳香族アミン類等)、電子輸送材料(例えば、Alq₃、ピラゾリン類等)、又は一般に赤色発光

用ドーパントとして用いられる一連の化合物(DCM及びその類似化合物、ポルフィリン類、フタロシアニン類、ペリレン化合物、ナイルレッド、スクアリリウム化合物等)が挙げられる(以下、同様)。

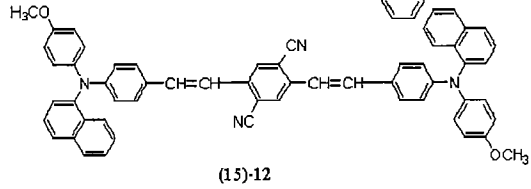
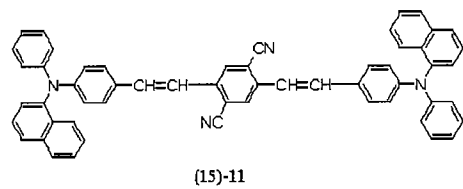
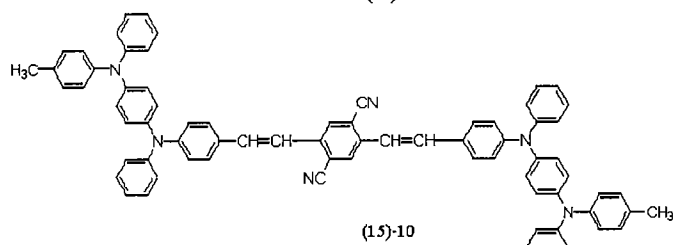
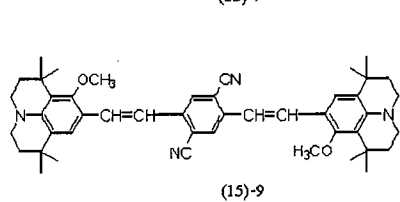
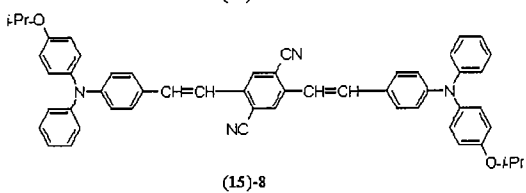
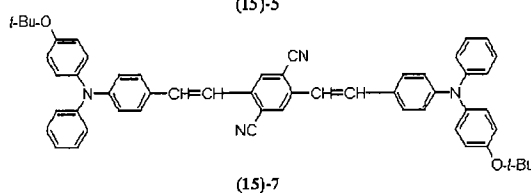
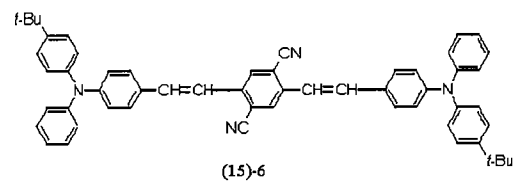
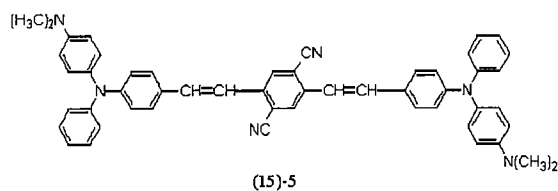
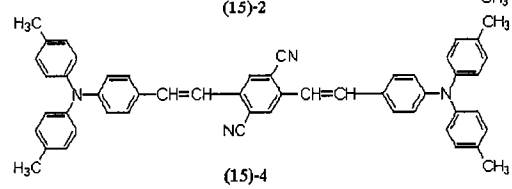
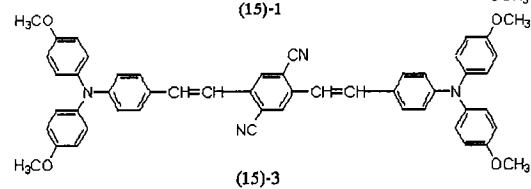
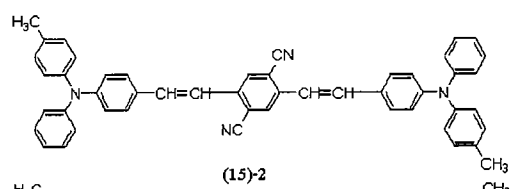
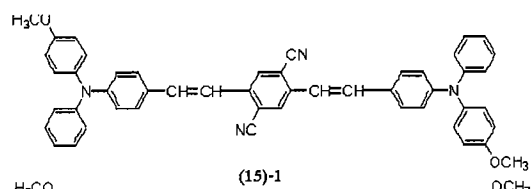
【0026】この場合、混合物層において上記アミノスチリル化合物の少なくとも1種は、その他の化合物と混合する場合、重量比で0.1〜95%の割合で含有されており、この範囲内でドーパントとしての含有量を定めることができる(以下、同様)。

【0027】なお、ここで「混合物層」とは、典型的には、上記アミノスチリル化合物とその他の化合物との混合物層を意味するが、これ以外にも、上記アミノスチリル化合物に包含される2種又はそれ以上のアミノスチリル化合物の混合物層も意味する場合がある。このような混合物層とすることによって、複数の化合物の組み合わせで所望の輝度や色度の赤色発光を生ぜしめることができる。

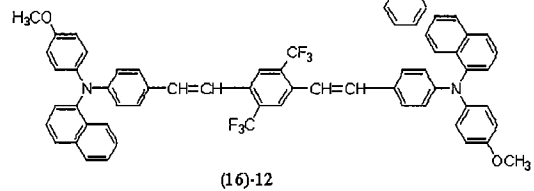
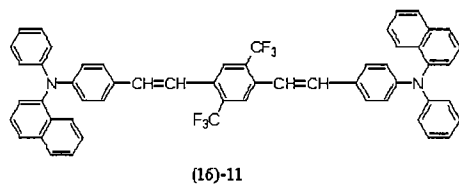
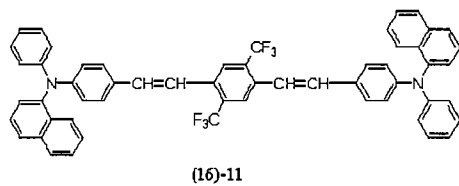
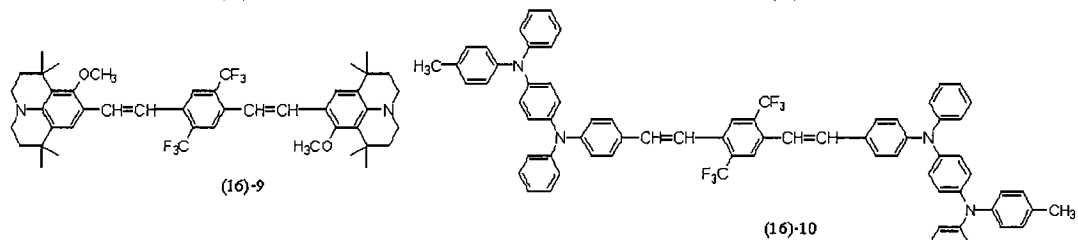
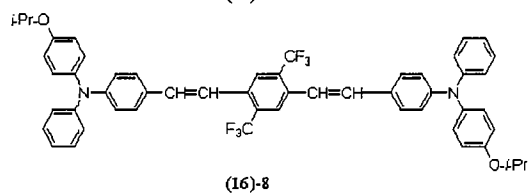
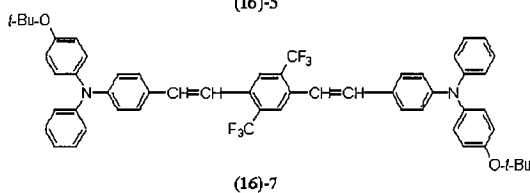
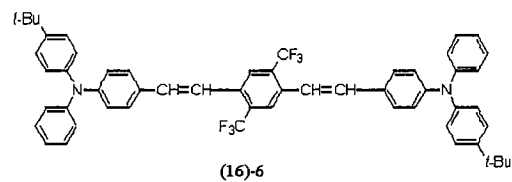
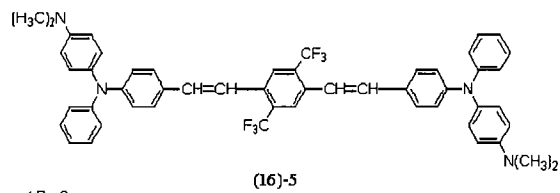
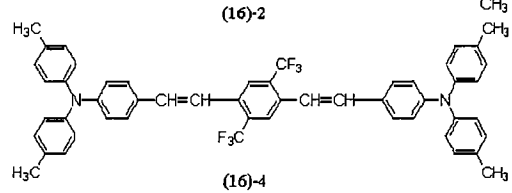
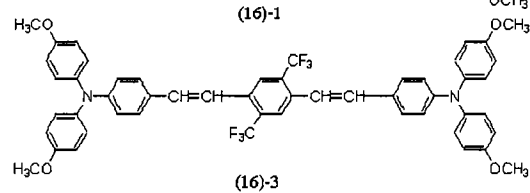
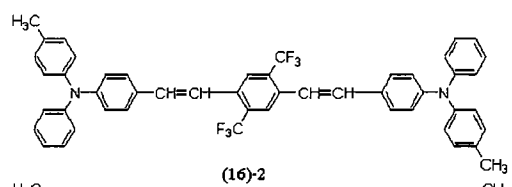
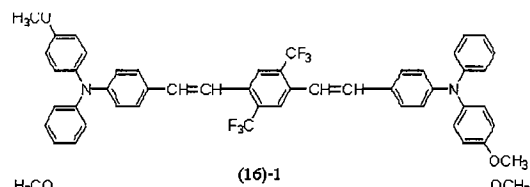
【0028】本発明の有機電界発光素子は、例えばディスプレイデバイスとして構成された発光装置に用いて好適なものである(以下、同様)。

【0029】本発明はまた、発光領域を有する有機層が陽極と陰極との間に設けられている有機電界発光素子において、前記有機層の構成層のうちの少なくとも1層が、下記構造式(15)−1〜(15)−12、(16)−1〜(16)−12、(17)−1〜(17)−6、及び(18)−1〜(18)−6で表されるアミノスチリル化合物の少なくとも1種(1種であってよいが、2種又はそれ以上であってもよい。)を含んだ混合物層からなることを特徴とする有機電界発光素子(以下、本発明の第2の有機EL素子と称することがある。)を提供するものである。

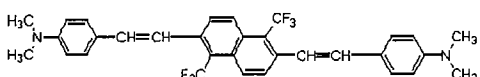
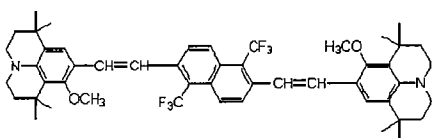
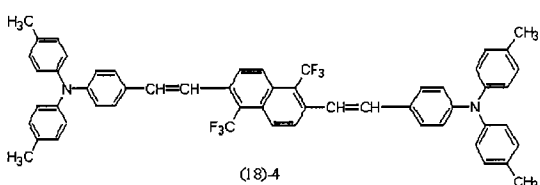
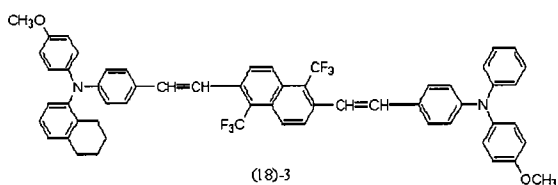
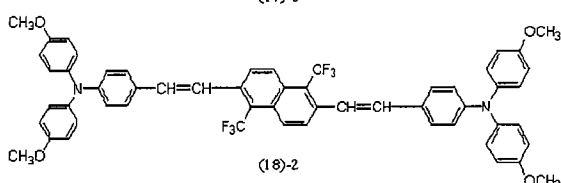
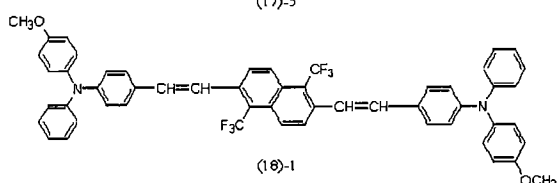
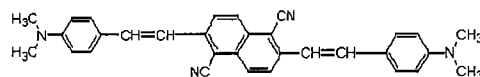
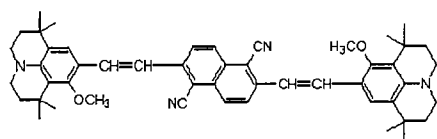
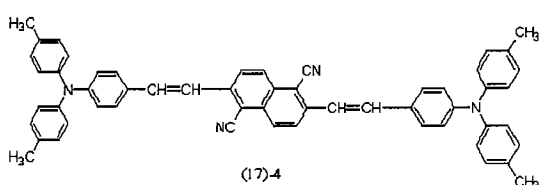
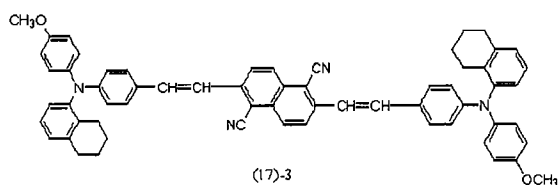
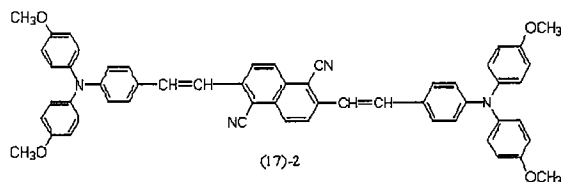
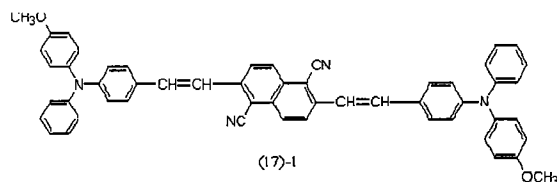
【化30】



【化 3 1】



【化 3 2】



【0030】本発明の第2の有機EL素子において、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも電子輸送層が、前記アミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなっている。

【0031】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくともホール輸送層が、前記アミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなっている。

【0032】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が、前記アミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなり、かつ前記電子輸送層が、前記アミノスチリル化合物の少なくとも1種を含んだ前記混合物層からなっている。

【0033】また、前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも発光層が、前

混合物層からなっている。

【0034】また、前記有機層の構成層のうちの前記少なくとも1層が、前記アミノスチリル化合物の少なくとも1種と、600nm以上、例えば600～700nm（以下、同様）の範囲に発光極大を有する赤色発光色素とを含んだ前記混合物層からなっている。

【0035】この場合、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機層の構成層のうちの前記少なくとも1層が少なくとも前記電子輸送層であってよい。

【0036】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機層の構成層のうちの前記少なくとも1層が少なくとも前記ホール輸送層であってよい。

【0037】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が、前記アミノスチリル化合物の少なくとも1種と、600nm以上の範囲に発光極大を有する赤色発光色素とを含んだ前記混合物層からなり、かつ前記電子輸送層が、前記アミノスチリル化合物の少なくとも1種

とを含んだ前記混合物層からってよい。

【0038】また、前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記発光層が、前記アミノスチリル化合物の少なくとも1種と、60nm以上の範囲に発光極大を有する赤色発光色素とを含んだ前記混合物層からなっている。

【0039】本発明はまた、発光領域を有する有機層が陽極と陰極との間に設けられている有機電界発光素子において、前記有機層の構成層のうちの少なくとも1層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種（1種であってよいが2種又はそれ以上であってもよい。）を含んだ発光性の混合物層からなり、かつ前記発光性の混合物層の陰極側に（特に接して）ホールブロッキング層が存在することを特徴とする有機電界発光素子（以下、本発明の第3の有機EL素子と称することがある。）を提供するものである。

【0040】本発明の第3の有機EL素子において、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記電子輸送層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記発光性の混合物層からなっている。

【0041】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記ホール輸送層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記発光性の混合物層からなっている。

【0042】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記発光性の混合物層からなり、前記電子輸送層が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記発光性の混合物層からなり、かつこの電子輸送性の発光性の混合物層の陰極側に前記ホールブロッキング層が存在している。

【0043】また、前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記発光層

が、前記一般式〔I〕で表されるアミノスチリル化合物の少なくとも1種を含んだ前記発光性の混合物層からなっている。

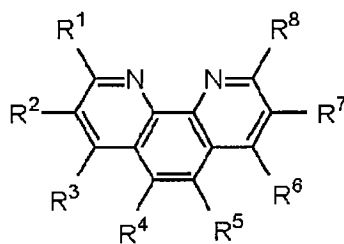
【0044】本発明の第3の有機EL素子において、前記ホールブロッキング層は、発光層でのホールと電子の再結合を促進し、さらに高輝度かつ高効率な発光を得ることができるものであって、このようなホールブロッキング層に適した材料は、次のようなエネルギー状態を有するものであることが望ましい（以下、同様）。すなわち、ホールブロッキング層を形成する材料の最高占有分子軌道レベルが、ホールブロッキング層の陽極側に接する層を形成する材料の最高占有分子軌道レベルより低いエネルギーレベルにあること、なおかつ、ホールブロッキング層を形成する材料の最低非占有分子軌道レベルが、ホールブロッキング層の陽極側に接する層を形成する材料の最低非占有分子軌道レベルより高いエネルギーレベルにあり、またホールブロッキング層の陰極側に接する層を形成する材料の最低非占有分子軌道レベルより低いエネルギーレベルにあることである。

【0045】このような材料として、特開平10-79297号、特開平11-204258号、特開平11-204264号、特開平11-204259号の各公報等に示されたフェナントロリン誘導体が挙げられるが、上記のエネルギーレベルの条件を満たすものであれば、フェナントロリン誘導体に限定されるものではない。使用可能なフェナントロリン誘導体を下記に示す。

【0046】

【化33】

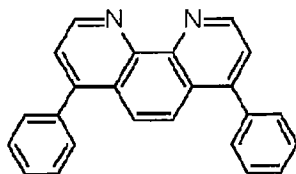
フェナントロリン誘導体の一般式：



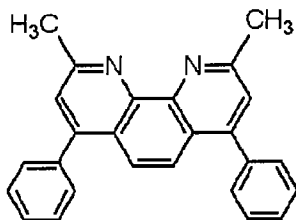
（この一般式中、R¹～R⁸は、水素原子、置換もしくは非置換のアルキル基、置換もしくは非置換のアリール基、置換もしくは非置換のアミノ基、ハロゲン原子、ニトロ基、シアノ基又は水酸基を表す。）

【化34】

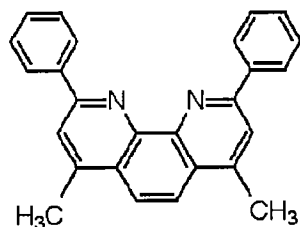
構造式 1 :



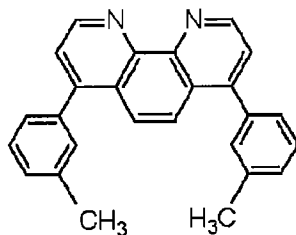
構造式 2 :



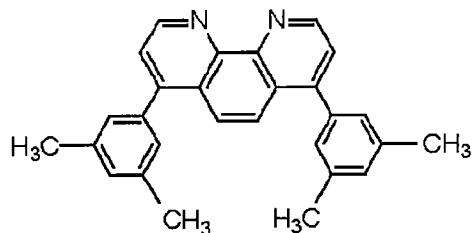
構造式 3 :



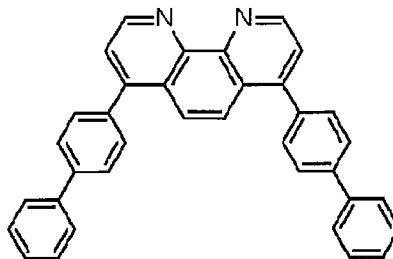
構造式 4 :



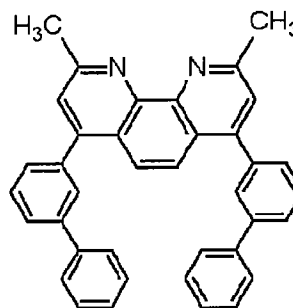
構造式 5 :



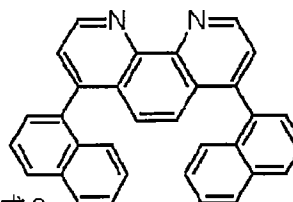
構造式 6 :



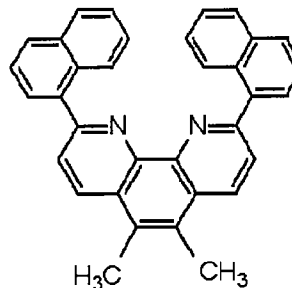
構造式 7 :



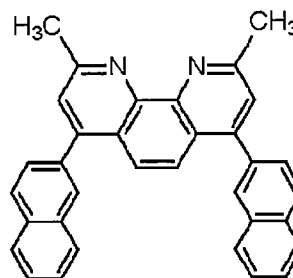
構造式 8 :



構造式 9 :



構造式 10 :



【0047】本発明はまた、発光領域を有する有機層が陽極と陰極との間に設けられている有機電界発光素子において、前記有機層の構成層のうちの少なくとも1層が、前記構造式(15)-1~(15)-12、(16)-1~(16)-12、(17)-1~(17)-6、及び(18)-1~(18)-6で表されるアミノスチリル化合物の少なくとも1種(1種であってよい

性の混合物層からなり、かつ前記発光性の混合物層の陰極側にホールブロッキング層が存在することを特徴とする有機電界発光素子(以下、本発明の第4の有機EL素子と称することがある。)を提供するものである。

【0048】本発明の第4の有機EL素子において、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの

少なくとも1種を含んだ前記発光性の混合物層からなっていてよい。

【0049】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくともホール輸送層が、前記アミノスチリル化合物の少なくとも1種を含んだ前記発光性の混合物層からなっていてよい。

【0050】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が、前記アミノスチリル化合物の少なくとも1種を含んだ前記発光性の混合物層からなり、前記電子輸送層が、前記アミノスチリル化合物の少なくとも1種を含んだ前記発光性の混合物層からなり、かつこの電子輸送性の発光性の混合物層の陰極側に前記ホールブロッキング層が存在していてよい。

【0051】また、前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも発光層が、前記アミノスチリル化合物の少なくとも1種を含んだ前記発光性の混合物層からなっていてよい。

【0052】また、前記有機層の構成層のうちの前記少なくとも1層が、前記アミノスチリル化合物の少なくとも1種と、600nm以上の範囲に発光極大を有する赤色発光色素とを含んだ前記発光性の混合物層からなっていてよい。

【0053】この場合、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機層の構成層のうちの前記少なくとも1層が少なくとも前記電子輸送層であってよい。

【0054】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機層の構成層のうちの前記少なくとも1層が少なくとも前記ホール輸送層であってよい。

【0055】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が、前記アミノスチリル化合物の少なくとも1種と、600nm以上の範囲に発光極大を有する赤色発光色素とを含んだ前記発光性の混合物層からなり、前記電子輸送層が、前記アミノスチリル化合物の少なくとも1種と、600nm以上の範囲に発光極大を有する赤色発光色素とを含んだ前記発光性の混合物層からなり、かつこの電子輸送性の発光性の混合物層の陰極側に前記ホールブロッキング層が存在していてよい。

【0056】また、前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記発光層が、前記アミノスチリル化合物の少なくとも1種と、600nm以上の範囲に発光極大を有する赤色発光色素とを含んだ前記発光性の混合物層からなっていてよい。

陽極と陰極との間に設けられている有機電界発光素子において、前記有機層の構成層のうちの少なくとも1層が、前記一般式〔I〕で表されるアミノスチリル化合物単独で構成されたアミノスチリル化合物層からなり、かつ前記アミノスチリル化合物層の陰極側に（特に接して）ホールブロッキング層が存在することを特徴とする有機電界発光素子（以下、本発明の第5の有機EL素子と称することがある。）を提供するものである。

【0058】本発明の第5の有機EL素子において、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記電子輸送層が前記アミノスチリル化合物層からなっていてよい。

【0059】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記ホール輸送層が前記アミノスチリル化合物層からなっていてよい。

【0060】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が前記アミノスチリル化合物層からなり、前記電子輸送層が前記アミノスチリル化合物層からなり、かつこの電子輸送性のアミノスチリル化合物層の陰極側に前記ホールブロッキング層が存在していてよい。

【0061】また、前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも前記発光層が前記アミノスチリル化合物層からなっていてよい。

【0062】本発明の第5の有機EL素子におけるホールブロッキング層は、本発明の第3の有機EL素子における前記ホールブロッキング層と同様に構成されていてよい。

【0063】本発明は更に、発光領域を有する有機層が陽極と陰極との間に設けられている有機電界発光素子において、前記有機層の構成層のうちの少なくとも1層が、前記構造式（15）-1～（15）-12、（16）-1～（16）-12、（17）-1～（17）-6、及び（18）-1～（18）-6で表されるアミノスチリル化合物単独で構成されたアミノスチリル化合物層からなり、かつ前記アミノスチリル化合物層の陰極側にホールブロッキング層が存在することを特徴とする有機電界発光素子（以下、本発明の第6の有機EL素子と称することがある。）も提供するものである。

【0064】本発明の第6の有機EL素子において、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも電子輸送層が前記アミノスチリル化合物層からなっていてよい。

【0065】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記

ミノスチリル化合物層からなっている。

【0066】また、前記有機層が、ホール輸送層と電子輸送層とが積層された有機積層構造をなしており、前記ホール輸送層が前記アミノスチリル化合物層からなり、かつこの電子輸送性のアミノスチリル化合物層の陰極側に前記ホールブロッキング層が存在している。

【0067】また、前記有機層が、ホール輸送層と発光層と電子輸送層とが積層された有機積層構造をなしており、前記有機積層構造のうちの少なくとも発光層が前記アミノスチリル化合物層からなっている。

【0068】図1～図9には、本発明に基づく有機電界発光素子（有機EL素子）の例をそれぞれ示す。

【0069】図1は、陰極3を発光光20が透過する透過型有機電界発光素子Aであって、発光光20は保護層4の側からも観測できる。図2は、陰極3での反射光も発光光20として得る反射型有機電界発光素子Bを示す。

【0070】図中、1は有機電界発光素子を形成するための基板である。ガラス、プラスチック及び他の適宜の材料を用いることができる。また、有機電界発光素子を他の表示素子と組み合わせて用いる場合には、基板を共用することもできる。2は透明電極であり、ITO（Indium tin oxide）、 SnO_2 等が使用できる。

【0071】また、5は有機発光層であり、上記したアミノスチリル化合物を発光材料として含有している（但し、上記アミノスチリル化合物は、少なくとも1種がその他の化合物と混合して、或いは複数種のアミノスチリル化合物を併用して含有：以下、同様）。この発光層について、有機電界発光20を得る層構成としては、従来公知の種々の構成を用いることができる。後記するように、例えば、正孔（ホール）輸送層と電子輸送層のいずれかを構成する材料が発光性を有する場合、これらの薄膜を積層した構造が使用できる。更に、本発明の目的を満たす範囲で電荷輸送性能を上げるために、正孔輸送層と電子輸送層のいずれか若しくは両方が、複数種の材料の薄膜を積層した構造、又は、複数種の材料を混合した組成からなる薄膜を使用するのを妨げない。また、発光性能を上げるために、少なくとも1種以上の蛍光性の材料を用いて、この薄膜を正孔輸送層と電子輸送層の間に挟持した構造、更に少なくとも1種以上の蛍光性の材料を正孔輸送層若しくは電子輸送層、又はこれらの両方に含ませた構造を使用してもよい。これらの場合には、発光効率を改善するために、正孔（ホール）又は電子の輸送を制御するための薄膜をその層構成に含ませることも可能である。

【0072】上記の一般式〔I〕で表したアミノスチリル化合物は、電子輸送性能と正孔輸送性能の両方を持つ

ても、或いは正孔輸送性材料との混合発光層としても用いることが可能である。また、該化合物を含む混合層を電子輸送層と正孔輸送層に挟み込んだ構成で発光材料として用いることも可能である。

【0073】なお、図1及び図2中、3は陰極であり、電極材料としては、Li、Mg、Ca等の活性な金属とAg、Al、In等の金属との合金或いは積層した構造が使用できる。透過型の有機電界発光素子においては、陰極の厚さを調節することにより、用途に合った光透過率を得ることができる。また、図中、4は封止、保護層であり、有機電界発光素子全体を覆う構造とすることで、その効果が上がる。気密性が保たれば、適宜の材料を使用することができる。

【0074】本発明に基づく有機電界発光素子においては、有機層が、正孔輸送層と電子輸送層とが積層された有機積層構造（シングルヘテロ構造）を有しており、正孔輸送層又は電子輸送層の形成材料として前記アミノスチリル化合物を含む混合物層が用いられてよい。或いは、有機層が正孔輸送層と発光層と電子輸送層とが順次積層された有機積層構造（ダブルヘテロ構造）を有しており、発光層の形成材料として前記スチリル化合物を含む混合物層が用いられてよい。

【0075】このような有機積層構造を有する有機電界発光素子の例を示すと、図3は、透光性の基板1上に、透光性の陽極2と、正孔輸送層6と電子輸送層7とからなる有機層5aと、陰極3とが順次積層された積層構造を有し、この積層構造が保護層4によって封止されてなる、シングルヘテロ構造の有機電界発光素子Cである。

【0076】図3に示すように発光層を省略した層構成の場合には、正孔輸送層6と電子輸送層7の界面から所定波長の発光20を発生する。これらの発光は基板1側から観測される。

【0077】また、図4は、透光性の基板1上に、透光性の陽極2と、正孔輸送層10と発光層11と電子輸送層12とからなる有機層5bと、陰極3とが順次積層された積層構造を有し、この積層構造が保護層4によって封止されてなる、ダブルヘテロ構造の有機電界発光素子Dである。

【0078】図4に示した有機電界発光素子においては、陽極2と陰極3の間に直流電圧を印加することにより、陽極2から注入された正孔が正孔輸送層10を経て、また陰極3から注入された電子が電子輸送層12を経て、それぞれ発光層11に到達する。この結果、発光層11においては電子／正孔の再結合が生じて一重項励起子が生成し、この一重項励起子から所定波長の発光を発生する。

【0079】上述した各有機電界発光素子C、Dにおいて、基板1は、例えば、ガラス、プラスチック等の光透過性の材料を適宜用いることができる。また、他の表示

た積層構造をマトリックス状に配置する場合等は、この基板を共用してもよい。また、素子C、Dはいずれも透過型、反射型のいずれの構造も採りうる。

【0080】また、陽極2は、透明電極であり、ITOやSnO₂等が使用できる。この陽極2と正孔輸送層6（又は正孔輸送層10）との間には、電荷注入効率を改善する目的で、有機物もしくは有機金属化合物からなる薄膜を設けてもよい。なお、保護層4が金属等の導電性材料で形成されている場合は、陽極2の側面に絶縁膜が設けられていてもよい。

【0081】また、有機電界発光素子Cにおける有機層5aは、正孔輸送層6と電子輸送層7とが積層された有機層であり、これらのいずれか又は双方に上記したアミノスチリル化合物を含む混合物が含有され、発光性の正孔輸送層6又は電子輸送層7としてよい。有機電界発光素子Dにおける有機層5bは、正孔輸送層10と上記したアミノスチリル化合物を含む混合物からなる発光層11と電子輸送層12とが積層された有機層であるが、その他、種々の積層構造を採ることができる。例えば、正孔輸送層と電子輸送層のいずれか若しくは両方が発光してもよい。

【0082】また、正孔輸送層において、正孔輸送性能を向上させるため、複数種の正孔輸送材料を積層した正孔輸送層を形成してもよい。

【0083】また、有機電界発光素子Cにおいて、発光層は電子輸送性発光層7であってよいが、電源8から印加される電圧によっては、正孔輸送層6やその界面で発光される場合がある。同様に、有機電界発光素子Dにおいて、発光層は層11以外に、電子輸送層12であってよく、正孔輸送層10であってよい。発光性能を向上させるため、少なくとも1種の蛍光性材料を用いた発光層11を正孔輸送層と電子輸送層との間に挟持させた構造であるのがよい。或いは、この蛍光性材料を正孔輸送層又は電子輸送層、或いはこれら両層に含有させた構造を構成してよい。このような場合、発光効率を改善するために、正孔又は電子の輸送を制御するための薄膜（ホールプロッキング層やエキシトン生成層など）をその層構成に含ませることも可能である。

【0084】また、陰極3に用いる材料としては、Li、Mg、Ca等の活性な金属とAg、Al、In等の金属との合金を使用でき、これらの金属層が積層した構造であってもよい。なお、陰極の厚みや材質を適宜選択することによって、用途に見合った有機電界発光素子を作製できる。

【0085】また、保護層4は、封止膜として作用するものであり、有機電界発光素子全体を覆う構造とすることにより、電荷注入効率や発光効率を向上できる。なお、その気密性が保たれれば、アルミニウム、金、クロム等の単金属又は合金など、適宜その材料を選択でき

【0086】上記した各有機電界発光素子に印加する電流は通常、直流であるが、パルス電流や交流を用いてもよい。電流値、電圧値は、素子破壊しない範囲内であれば特に制限はないが、有機電界発光素子の消費電力や寿命を考慮すると、なるべく小さい電気エネルギーで効率良く発光させることが望ましい。

【0087】図5～図9には、図1～図4に示した有機EL素子A～Dにおいて、発光層5、正孔輸送層6、電子輸送層7又は発光層11の陰極3側に接してホールプロッキング層30を設けた例A'～D'をそれぞれ示す。ここでは、上記アミノスチリル化合物は、上述したように、少なくとも1種がその他の化合物と混合されている以外にも、複数のアミノスチリル化合物が併用されていてもよい。或いは、単一のアミノスチリル化合物単独で層をなしていてもよい。

【0088】次に、図10は、本発明の有機電界発光素子を用いた平面ディスプレイの構成例である。図示の如く、例えばフルカラーディスプレイの場合は、赤（R）、緑（G）及び青（B）の3原色を発光可能な有機層5（5a, 5b）が、陰極3と陽極2との間に配されている。陰極3及び陽極2は、互いに交差するストライプ状に設けることができ、輝度信号回路14及びシフトレジスタ内蔵の制御回路15により選択されて、それぞれに信号電圧が印加され、これによって、選択された陰極3及び陽極2が交差する位置（画素）の有機層が発光するように構成されている。

【0089】即ち、図10は例えば8×3RGB単純マトリックスであって、正孔輸送層と、発光層及び電子輸送層のいずれか少なくとも一つからなる積層体5を陰極3と陽極2の間に配設したものである（図3又は図4参照）。陰極と陽極は、ともにストライプ状にパターンニングするとともに、互いにマトリクス状に直交させ、シフトレジスタ内蔵の制御回路15及び輝度信号回路14により時系列的に信号電圧を印加し、その交叉位置で発光するように構成されたものである。かかる構成のEL素子は、文字・記号等のディスプレイとしては勿論、画像再生装置としても使用できる。また、陰極3と陽極2のストライプ状パターンを赤（R）、緑（G）、青（B）の各色毎に配し、マルチカラーあるいはフルカラーの全固体型フラットパネルディスプレイを構成することが可能となる。

【0090】

【実施例】次に、本発明の実施例を示すが、本発明はこれに限定されるものではない。

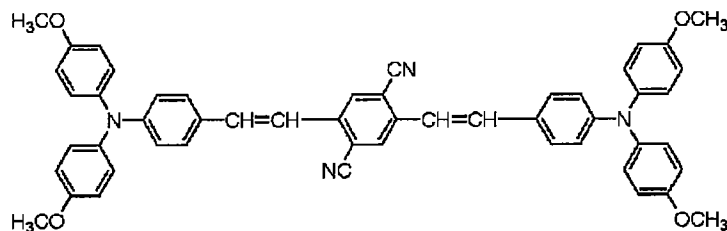
【0091】実施例1

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(15)－3のアミノスチリル化合物と α -NPD（ α -ナフチルフェニルジアミン）との混合物層を正孔輸送性発光層として用い、シングルヘ

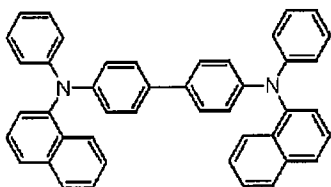
【0092】

【化35】

構造式(15)-3:



【化36】

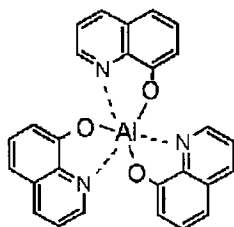
 α -NPD:

【0093】まず、真空蒸着装置中に、100nmの厚さのITOからなる陽極が一表面に形成された30mm×30mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0mm×2.0mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により 10^{-4} Pa以下の真空中で上記構造式(15)-3のアミノスチリル化合物と正孔輸送材料である α -NPDとを重量比1:1で混合した層を例えば50nmの厚さに正孔輸送層(兼発光層)として成膜した。蒸着レートは各々0.1nm/秒とした。

【0094】さらに、電子輸送層材料として下記構造式のAlq₃(トリス(8-キノリノール)アルミニウム)を正孔輸送層に接して蒸着した。Alq₃からなるこの電子輸送層の膜厚も例えば50nmとし、蒸着レートは0.2nm/秒とした。

【0095】

【化37】

Alq₃:

【0096】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1nm/秒として例えば50nm(Mg膜)及び150nm(Ag膜)の厚さに形成し、実施例1による図3に示した如き有機電界発光素子を作製した。

【0097】このように作製した実施例1の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、分光測定を

クトルを得た。分光測定は、大塚電子社製のフォトダイオードアレイを検出器とした分光器を用いた。また、電圧-輝度測定を行ったところ、8Vで2000cd/m²の輝度が得られた。

【0098】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで900時間であった。

【0099】実施例2

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)-3のアミノスチリル化合物とAlq₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0100】まず、真空蒸着装置中に、100nmの厚さのITOからなる陽極が一表面に形成された30mm×30mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0mm×2.0mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により 10^{-4} Pa以下の真空中で前記構造式の α -NPDを例えば50nmの厚さに成膜した。蒸着レートは0.1nm/秒とした。

【0101】さらに、上記構造式(15)-3のアミノスチリル化合物と電子輸送性材料であるAlq₃とを重量比1:1で混合した層を正孔輸送層に接して蒸着した。上記構造式(15)-3のアミノスチリル化合物とAlq₃とからなる電子輸送層(兼発光層)の膜厚も例えば50nmとし、蒸着レートは各々0.2nm/秒とした。

【0102】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1nm/秒として例えば50nm(Mg)及び150nm(Ag膜)の厚さに形成し、図3に示した如き有機電界発光素子を作製した。

【0103】このように作製した実施例2の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、630nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定

られた。

【0104】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 $200\text{cd}/\text{m}^2$ で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで800時間であった。

【0105】実施例3

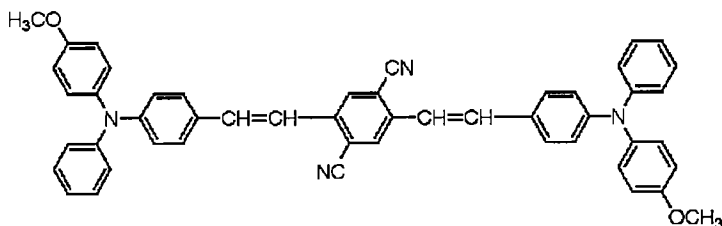
本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－3のアミノスチリル化合物と Alq_3 との混合物層を電子輸送性発光層として用い、ダブルヘテロ構造の有機電界発光素子を作製した例である。

【0106】まず、真空蒸着装置中に、100nmの厚さのITOからなる陽極が一表面に形成された30mm×30mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0mm×2.0mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により 10^{-4}Pa 以下の真空下で上記構造式の $\alpha\text{-NPD}$ を例えば30nmの厚さに成膜した。蒸着レートは0.2nm/秒とした。

【0107】さらに、発光材料として上記構造式(15)－3のアミノスチリル化合物と Alq_3 とを重量比1:1で正孔輸送層に接して蒸着した。上記構造式(15)－3のアミノスチリル化合物と Alq_3 との混合物層からなる発光層の膜厚も例えば30nmとし、蒸着レートは各々0.2nm/秒とした。

【0108】さらに、電子輸送性材料として上記構造式の Alq_3 を発光層に接して蒸着した。 Alq_3 の膜厚を

構造式(15)－1:



【0114】まず、真空蒸着装置中に、100nmの厚さのITOからなる陽極が一表面に形成された30mm×30mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0mm×2.0mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により 10^{-4}Pa 以下の真空下で上記構造式の $\alpha\text{-NPD}$ を例えば30nmの厚さに成膜した。蒸着レートは0.2nm/秒とした。

【0115】さらに、発光材料として上記構造式(15)－3のアミノスチリル化合物と上記構造式(15)－1のアミノスチリル化合物とを重量比1:3で正孔輸送層に接して共蒸着した。上記構造式(15)－3のアミノスチリル化合物と上記構造式(15)－1のアミノスチリル化合物との混合物層からなる発光層の膜厚も例

例えば30nmとし、蒸着レートは0.2nm/秒とした。

【0109】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1nm/秒として例えば50nm(Mg)及び150nm(Ag膜)の厚さに形成し、実施例3による図4に示した如き有機電界発光素子を作製した。

【0110】このように作製した実施例3の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、630nmに発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで $2500\text{cd}/\text{m}^2$ の輝度が得られた。

【0111】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 $200\text{cd}/\text{m}^2$ で電流値を一定に通電して連続発光して強制劣化させた際、輝度が半減するまで1500時間であった。

【0112】実施例4

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－3のアミノスチリル化合物と下記構造式(15)－1のアミノスチリル化合物との混合物層を発光層として用い、ダブルヘテロ構造の有機電界発光素子を作製した例である。

【0113】

【化38】

3の化合物は0.1nm/秒、上記構造式(15)－1の化合物は0.3nm/秒とした。

【0116】さらに、電子輸送性材料として上記構造式の Alq_3 を発光層に接して蒸着した。 Alq_3 の膜厚を例えば30nmとし、蒸着レートは0.2nm/秒とした。

【0117】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1nm/秒として例えば50nm(Mg)及び150nm(Ag膜)の厚さに形成し、実施例3による図4に示した如き有機電界発光素子を作製した。

【0118】このように作製した実施例4の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と

を有するスペクトルを得た。電圧－輝度測定を行ったところ、8 Vで3000 cd/m²の輝度が得られた。

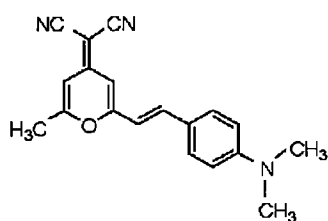
【0119】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200 cd/m²で電流値を一定に通電して連続発光して強制劣化させた際、輝度が半減するまで1200時間であった。

【0120】実施例5

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－3のアミノスチリル化合物と下記構造式のDCMとの混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【化39】

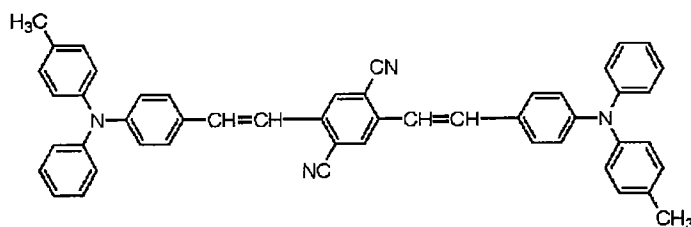
DCM:



【0121】まず、真空蒸着装置中に、100 nmの厚さのITOからなる陽極が一表面に形成された30 mm×30 mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0 mm×2.0 mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により10⁻⁴ Pa以下の真空下で上記構造式のα-NPDを例えば50 nmの厚さに成膜した。蒸着レートは0.1 nm/秒とした。

【0122】さらに、上記構造式(15)－3のアミノスチリル化合物と上記DCMとを重量比10:1で混合

構造式(15)－2:



【0128】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0129】このように作製した実施例6の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は橙色であり、実施例1と同様に分光測定を行った結果、590 nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8 Vで850 cd/m²の輝度が得られた。

【0130】この有機電界発光素子を作製後、窒素雰

した層を正孔輸送層に接して蒸着した。上記構造式(15)－3のアミノスチリル化合物と上記DCMからなる電子輸送層(兼発光層)の膜厚も例えば50 nmとし、蒸着レートは上記構造式(15)－3の化合物は0.5 nm/秒、DCMは0.05 nm/秒とした。

【0123】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1 nm/秒として例えば50 nm(Mg)及び150 nm(Ag膜)の厚さに形成し、図3に示した如き有機電界発光素子を作製した。

【0124】このように作製した実施例5の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、630 nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8 Vで800 cd/m²の輝度が得られた。

【0125】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200 cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで500時間であった。

【0126】実施例6

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(15)－2のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0127】

【化40】

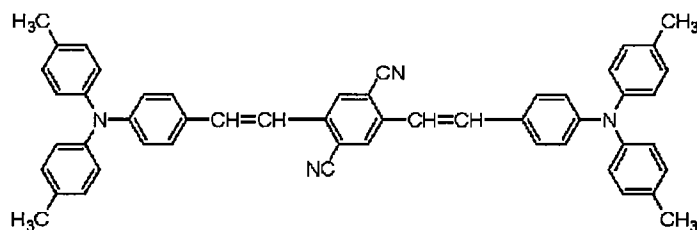
た。また、初期輝度200 cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで600時間であった。

【0131】実施例7

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(15)－4のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0132】

構造式(15) - 4 :



【0133】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0134】このように作製した実施例7の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、610nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで800cd/m²の輝度が得られた。

【0135】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかつ

た。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで450時間であった。

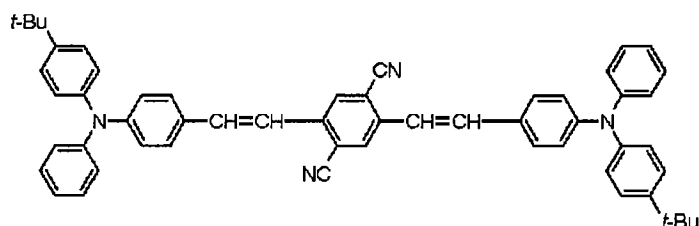
【0136】実施例8

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(15)-6のアミノスチリル化合物とAlq₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0137】

【化42】

構造式(15) - 6 :



【0138】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0139】このように作製した実施例8の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は橙色であり、実施例1と同様に分光測定を行った結果、585nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで500cd/m²の輝度が得られた。

【0140】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかつ

た。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで200時間であった。

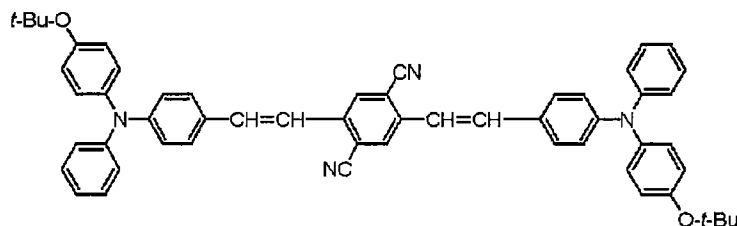
【0141】実施例9

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(15)-7のアミノスチリル化合物とAlq₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0142】

【化43】

構造式(15) - 7 :



【0143】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0144】このように作製した実施例9の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、615nm付近に発光ピ

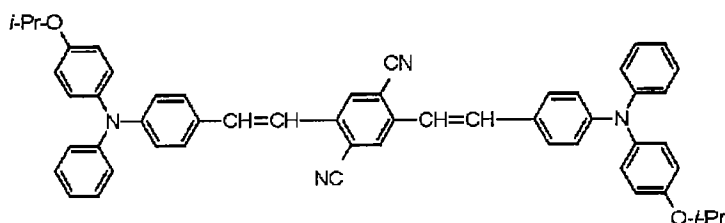
を行ったところ、8Vで580cd/m²の輝度が得られた。

【0145】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減す

【0146】実施例10

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(15)－8のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用

構造式(15)－8：



【0148】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0149】このように作製した実施例10の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、610nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで430cd/m²の輝度が得られた。

【0150】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで150時間であった。

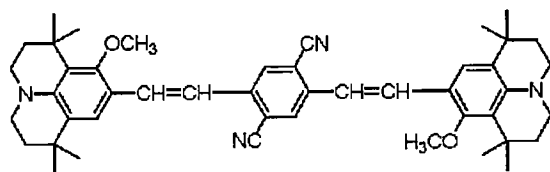
【0151】実施例11

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(15)－9のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

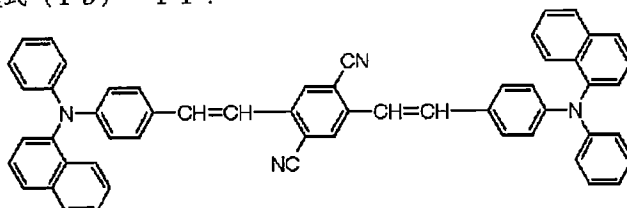
【0152】

【化45】

構造式(15)－9：



構造式(15)－11：



【0158】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0159】このように作製した実施例12の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加え

い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0147】

【化44】

【0153】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0154】このように作製した実施例11の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、640nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで800cd/m²の輝度が得られた。

【0155】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで450時間であった。

【0156】実施例12

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(15)－11のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0157】

【化46】

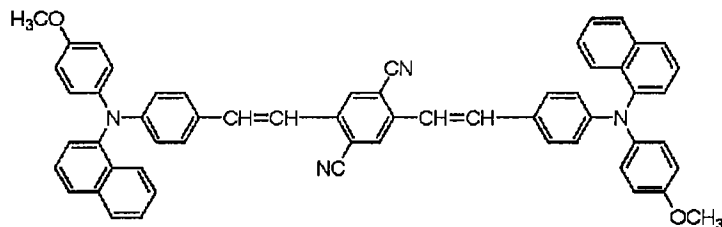
と同様に分光測定を行った結果、580nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで1000cd/m²の輝度が得られた。

気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで750時間であった。

【0161】実施例13

本実施例は、上述の一般式[I]のアミノスチリル化合物

構造式(15)-12:

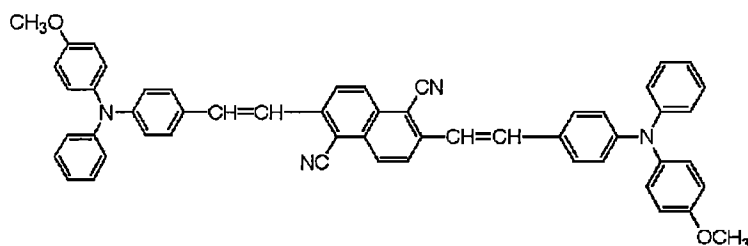


【0163】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0164】このように作製した実施例13の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は橙色であり、実施例1と同様に分光測定を行った結果、 600 nm 付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、 8 V で 850 cd/m^2 の輝度が得られた。

【0165】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかつ

構造式(17)-1:



【0168】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0169】このように作製した実施例14の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、 620 nm 付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、 8 V で 1500 cd/m^2 の輝度が得られた。

【0170】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかつ

のうち、下記構造式(15)-12のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0162】

【化47】

た。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで600時間であった。

【0166】実施例14

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(17)-1のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0167】

【化48】

た。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで800時間であった。

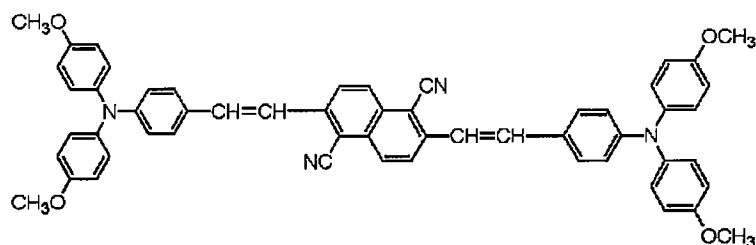
【0171】実施例15

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(17)-2のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0172】

【化49】

構造式 (17) - 2 :



【0173】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0174】このように作製した実施例15の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、645nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで1200cd/m²の輝度が得られた。

【0175】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかつ

た。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで700時間であった。

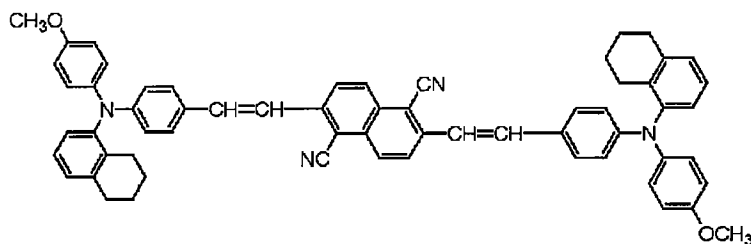
【0176】実施例16

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(17)-3のアミノスチリル化合物とAlq₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0177】

【化50】

構造式 (17) - 3 :



【0178】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0179】このように作製した実施例16の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、590nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで780cd/m²の輝度が得られた。

【0180】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかつ

た。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで500時間であった。

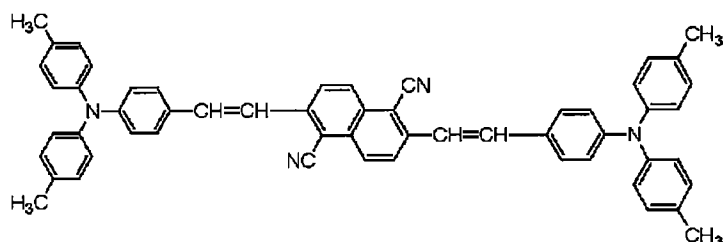
【0181】実施例17

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(17)-4のアミノスチリル化合物とAlq₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0182】

【化51】

構造式 (17) - 4 :



【0183】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0184】このように作製した実施例17の有機電界

発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、620nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測

得られた。

【0185】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで600時間であった。

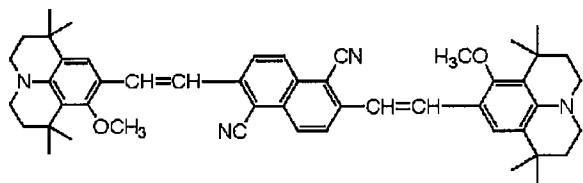
【0186】実施例18

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(17)－5のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0187】

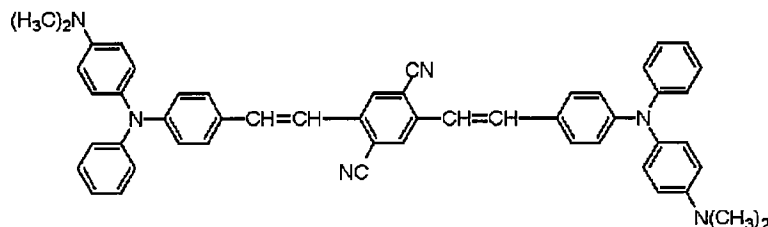
【化52】

構造式(17)－5：



【0188】層構造、成膜法とも実施例2に準拠して有

構造式(15)－5：



【0193】層構造、成膜法とも実施例2に準拠して有機電界発光素子を作製した。

【0194】このように作製した実施例19の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、655nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで 1500 cd/m^2 の輝度が得られた。

【0195】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで700時間であった。

【0196】実施例20

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－3のアミノスチリル化合物と α -NPDとの混合物層を正孔輸送性発光層として用い、さらに上記構造式(15)－3のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層としたシングルヘテロ構造の有機電界発光素子を作製した例

機電界発光素子を作製した。

【0189】このように作製した実施例18の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例1と同様に分光測定を行った結果、650nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで 700 cd/m^2 の輝度が得られた。

【0190】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで400時間であった。

【0191】実施例19

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、下記構造式(15)－5のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用い、シングルヘテロ構造の有機電界発光素子を作製した例である。

【0192】

【化53】

【0197】まず、真空蒸着装置中に、100nmの厚さのITOからなる陽極が一表面に形成された30mm×30mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0mm×2.0mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により 10^{-4} Pa 以下の真空下で上記構造式(15)－3のアミノスチリル化合物と正孔輸送材料である α -NPDを重量比1：1で混合した層を例えば50nmの厚さに正孔輸送層(兼発光層)として成膜した。蒸着レートは各々0.1nm/秒とした。

【0198】さらに、上記構造式(15)－3の化合物と電子輸送性材料であるA1q₃とを重量比1：1で混合した層を正孔輸送層(兼発光層)に接して蒸着した。上記構造式(15)－3の化合物とA1q₃とからなる電子輸送層(兼発光層)の膜厚も例えば50nmとし、蒸着レートは各々0.2nm/秒とした。

【0199】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1nm/秒として例えば50nm(Mg膜)及び150nm(Ag膜)の厚さに形成し、実施例20による図3に示した如き有機電界発光素子を作製した。

発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、分光測定を行った結果、635 nm付近に発光ピークを有するスペクトルを得た。分光測定は、大塚電子社製のフォトダイオードアレイを検出器とした分光器を用いた。また、電圧－輝度測定を行ったところ、8 Vで1800 cd/m²の輝度が得られた。

【0201】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200 cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで1000時間であった。

【0202】実施例21

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－3のアミノスチリル化合物と α -NPD (α -ナフチルフェニルジアミン)との混合物層を正孔輸送性発光層として用いた有機電界発光素子を作製した例である。

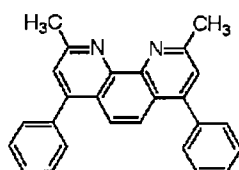
【0203】まず、真空蒸着装置中に、100 nmの厚さのITOからなる陽極が一表面に形成された30 mm×30 mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0 mm×2.0 mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により10⁻⁴ Pa以下の真空中で上記構造式(15)－3のアミノスチリル化合物と正孔輸送材料である α -NPDとを重量比1：1で混合した層を例えば50 nmの厚さに正孔輸送層（兼発光層）として成膜した。蒸着レートは各々0.1 nm/秒とした。

【0204】さらに、ホールブロッキング層材料として下記構造式のバソクプロインを正孔輸送層（兼発光層）に接して蒸着した。バソクプロインからなるこのホールブロッキング層の膜厚は例えば15 nmとし、蒸着レートは0.1 nm/秒とした。

【0205】

【化54】

バソクプロイン：



【0206】さらに、電子輸送層材料として上記構造式のA1q₃（トリス（8-キノリノール）アルミニウム）をホールブロッキング層に接して蒸着した。A1q₃からなるこの電子輸送層の膜厚も例えば50 nmとし、蒸着レートは0.2 nm/秒とした。

【0207】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1 nm/秒として例えば50 nm（Mg膜）及び150 nm（Ag膜）の

電界発光素子を作製した。

【0208】このように作製した実施例21の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、分光測定を行った結果、630 nm付近に発光ピークを有するスペクトルを得た。分光測定は、大塚電子社製のフォトダイオードアレイを検出器とした分光器を用いた。また、電圧－輝度測定を行ったところ、8 Vで2500 cd/m²の輝度が得られた。

【0209】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200 cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで1000時間であった。

【0210】実施例22

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－3のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0211】まず、真空蒸着装置中に、100 nmの厚さのITOからなる陽極が一表面に形成された30 mm×30 mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0 mm×2.0 mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により10⁻⁴ Pa以下の真空中で下記構造式の α -NPDを例えば30 nmの厚さに成膜した。蒸着レートは0.1 nm/秒とした。

【0212】さらに、上記構造式(15)－3の化合物と電子輸送性材料であるA1q₃とを重量比1：1で混合した層を正孔輸送層に接して共蒸着した。上記構造式(15)－3の化合物とA1q₃からなる電子輸送層（兼発光層）の膜厚も例えば30 nmとし、蒸着レートは各々0.2 nm/秒とした。

【0213】さらに、ホールブロッキング層材料として上記構造式のバソクプロインを正孔輸送層（兼発光層）に接して蒸着した。バソクプロインからなるこのホールブロッキング層の膜厚は例えば15 nmとし、蒸着レートは0.1 nm/秒とした。

【0214】さらに、電子輸送層材料として上記構造式のA1q₃をホールブロッキング層に接して蒸着した。A1q₃からなるこの電子輸送層の膜厚は例えば30 nmとし、蒸着レートは0.2 nm/秒とした。

【0215】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1 nm/秒として例えば50 nm（Mg）及び150 nm（Ag膜）の厚さに形成し、図9に示した如き有機電界発光素子を作製した。

【0216】このように作製した実施例22の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加え

1と同様に分光測定を行った結果、630 nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8 Vで3400 cd/m²の輝度が得られた。

【0217】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200 cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで1200時間であった。

【0218】実施例23

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－3のアミノスチリル化合物と上記構造式(15)－1のアミノスチリル化合物との混合物層を発光層として用いた有機電界発光素子を作製した例である。

【0219】まず、真空蒸着装置中に、100 nmの厚さのITOからなる陽極が一表面に形成された30 mm×30 mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0 mm×2.0 mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により10⁻⁴ Pa以下の真空下で上記構造式のα-NPDを例えば30 nmの厚さに成膜した。蒸着レートは0.2 nm/秒とした。

【0220】さらに、発光材料として上記構造式(15)－3の化合物と上記構造式(15)－1の化合物とを重量比1：3で正孔輸送層に接して共蒸着した。上記構造式(15)－3の化合物と上記構造式(15)－1の化合物との混合物層からなる発光層の膜厚も例えば30 nmとし、蒸着レートは上記構造式(15)－3の化合物は0.1 nm/秒、上記構造式(15)－1の化合物は0.3 nm/秒とした。

【0221】さらに、ホールブロッキング層材料として上記構造式のバソクプロインを発光層に接して蒸着した。バソクプロインからなるこのホールブロッキング層の膜厚は例えば15 nmとし、蒸着レートは0.1 nm/秒とした。

【0222】さらに、電子輸送性材料として上記構造式のAlq₃をホールブロッキング層に接して蒸着した。Alq₃の膜厚を例えば30 nmとし、蒸着レートは0.2 nm/秒とした。

【0223】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1 nm/秒として例えば50 nm (Mg) 及び150 nm (Ag膜)の厚さに形成し、実施例23による図9に示した如き有機電界発光素子を作製した。

【0224】このように作製した実施例23の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例21と同様に分光測定を行った結果、640 nmに発光ピ

を行ったところ、8 Vで4000 cd/m²の輝度が得られた。

【0225】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200 cd/m²で電流値を一定に通電して連続発光して強制劣化させた際、輝度が半減するまで1600時間であった。

【0226】実施例24

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－3のアミノスチリル化合物と上記構造式のDCMとの混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0227】まず、真空蒸着装置中に、100 nmの厚さのITOからなる陽極が一表面に形成された30 mm×30 mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0 mm×2.0 mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により10⁻⁴ Pa以下の真空下で上記構造式のα-NPDを例えば30 nmの厚さに成膜した。蒸着レートは0.1 nm/秒とした。

【0228】さらに、上記構造式(15)－3の化合物と上記DCMとを重量比10：1で混合した層を正孔輸送層に接して共蒸着した。上記構造式(15)－3の化合物と上記DCMとからなる電子輸送層(兼発光層)の膜厚も例えば30 nmとし、蒸着レートは上記構造式(15)－3の化合物は0.5 nm/秒、DCMは0.05 nm/秒とした。

【0229】さらに、ホールブロッキング層材料として上記構造式のバソクプロインを発光層に接して蒸着した。バソクプロインからなるこのホールブロッキング層の膜厚は例えば15 nmとし、蒸着レートは0.1 nm/秒とした。

【0230】さらに、電子輸送性材料として上記構造式のAlq₃をホールブロッキング層に接して蒸着した。Alq₃の膜厚を例えば30 nmとし、蒸着レートは0.2 nm/秒とした。

【0231】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1 nm/秒として例えば50 nm (Mg) 及び150 nm (Ag膜)の厚さに形成し、図9に示した如き有機電界発光素子を作製した。

【0232】このように作製した実施例24の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例21と同様に分光測定を行った結果、630 nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8 Vで1000 cd/m²の輝度が得られた。

【0233】この有機電界発光素子を作製後、窒素雰

た。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで 600 時間であった。

【0234】実施例25

本実施例は、上述の一般式 [I] のアミノスチリル化合物のうち、上記構造式 (15) - 2 のアミノスチリル化合物と Alq_3 との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0235】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0236】このように作製した実施例25の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は橙色であり、実施例21と同様に分光測定を行った結果、 590 nm 付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、 8 V で 1100 cd/m^2 の輝度が得られた。

【0237】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで 700 時間であった。

【0238】実施例26

本実施例は、上述の一般式 [I] のアミノスチリル化合物のうち、上記構造式 (15) - 4 のアミノスチリル化合物と Alq_3 との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0239】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0240】このように作製した実施例26の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例21と同様に分光測定を行った結果、 610 nm 付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、 8 V で 1000 cd/m^2 の輝度が得られた。

【0241】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで 550 時間であった。

【0242】実施例27

本実施例は、上述の一般式 [I] のアミノスチリル化合物のうち、上記構造式 (15) - 6 のアミノスチリル化合物と Alq_3 との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0243】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0244】このように作製した実施例27の有機電界

発光特性を評価した。発光色は橙色であり、実施例21と同様に分光測定を行った結果、 585 nm 付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、 8 V で 600 cd/m^2 の輝度が得られた。

【0245】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで 300 時間であった。

【0246】実施例28

本実施例は、上述の一般式 [I] のアミノスチリル化合物のうち、上記構造式 (15) - 7 のアミノスチリル化合物と Alq_3 との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0247】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0248】このように作製した実施例28の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例21と同様に分光測定を行った結果、 615 nm 付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、 8 V で 650 cd/m^2 の輝度が得られた。

【0249】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで 350 時間であった。

【0250】実施例29

本実施例は、上述の一般式 [I] のアミノスチリル化合物のうち、上記構造式 (15) - 8 のアミノスチリル化合物と Alq_3 との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0251】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0252】このように作製した実施例29の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例21と同様に分光測定を行った結果、 610 nm 付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、 8 V で 500 cd/m^2 の輝度が得られた。

【0253】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで 200 時間であった。

【0254】実施例30

のうち、上記構造式(15)－9のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0255】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0256】このように作製した実施例30の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例21と同様に分光測定を行った結果、640nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで920cd/m²の輝度が得られた。

【0257】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで480時間であった。

【0258】実施例31

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－11の化合物とA1q₃との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0259】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0260】このように作製した実施例31の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は橙色であり、実施例21と同様に分光測定を行った結果、580nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで1100cd/m²の輝度が得られた。

【0261】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで800時間であった。

【0262】実施例32

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－12のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0263】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0264】このように作製した実施例32の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は橙色であり、実施例21と同様に分光測定を行った結果、600nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで900cd/m²の輝度が

【0265】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで660時間であった。

【0266】実施例33

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(17)－1のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0267】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0268】このように作製した実施例33の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例21と同様に分光測定を行った結果、620nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで1650cd/m²の輝度が得られた。

【0269】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで880時間であった。

【0270】実施例34

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(17)－2のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0271】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0272】このように作製した実施例34の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例21と同様に分光測定を行った結果、645nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで1300cd/m²の輝度が得られた。

【0273】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで800時間であった。

【0274】実施例35

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(17)－3のアミノスチリル化合物とA1q₃との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0275】層構造、成膜法とも実施例22に準拠して

【0276】このように作製した実施例35の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例21と同様に分光測定を行った結果、600nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで1450cd/m²の輝度を得られた。

【0277】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで700時間であった。

【0278】実施例36

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(17)-4のアミノスチリル化合物とAlq₃との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0279】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0280】このように作製した実施例36の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例21と同様に分光測定を行った結果、620nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで1200cd/m²の輝度を得られた。

【0281】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで650時間であった。

【0282】実施例37

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(17)-5のアミノスチリル化合物とAlq₃との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0283】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0284】このように作製した実施例37の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例21と同様に分光測定を行った結果、650nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで800cd/m²の輝度を得られた。

【0285】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減す

【0286】実施例38

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)-5のアミノスチリル化合物とAlq₃との混合物層を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0287】層構造、成膜法とも実施例22に準拠して有機電界発光素子を作製した。

【0288】このように作製した実施例38の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例21と同様に分光測定を行った結果、655nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで1720cd/m²の輝度を得られた。

【0289】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで780時間であった。

【0290】実施例39

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)-3のアミノスチリル化合物と α -NPDとの混合物層を正孔輸送性発光層として用い、更に上記構造式(15)-3のアミノスチリル化合物とAlq₃との混合物層を電子輸送性発光層とした有機電界発光素子を作製した例である。

【0291】まず、真空蒸着装置中に、100nmの厚さのITOからなる陽極が一表面に形成された30mm×30mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0mm×2.0mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により10⁻⁴Pa以下の真空中で上記構造式(15)-3の化合物と正孔輸送材料である α -NPDとを重量比1:1で混合した層を例えば30nmの厚さに正孔輸送層(兼発光層)として成膜した。蒸着レートは各々0.1nm/秒とした。

【0292】さらに、上記構造式(15)-3の化合物と電子輸送性材料であるAlq₃とを重量比1:1で混合した層を正孔輸送層(兼発光層)に接して共蒸着した。上記構造式(15)-3の化合物とAlq₃とからなる電子輸送層(兼発光層)の膜厚も例えば30nmとし、蒸着レートは各々0.2nm/秒とした。

【0293】さらに、ホールブロッキング層材料として上記構造式のバソクプロインを電子輸送層(兼発光層)に接して蒸着した。バソクプロインからなるこのホールブロッキング層の膜厚は例えば15nmとし、蒸着レートは0.1nm/秒とした。

【0294】さらに、電子輸送性材料として上記構造式のAlq₃をホールブロッキング層に接して蒸着した。

0.2 nm/秒とした。

【0295】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1 nm/秒として例えば50 nm (Mg膜) 及び150 nm (Ag膜) の厚さに形成し、実施例39による図9に示した如き有機電界発光素子を作製した。

【0296】このように作製した実施例39の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、分光測定を行った結果、635 nm付近に発光ピークを有するスペクトルを得た。分光測定は、大塚電子社製のフォトダイオードアレイを検出器とした分光器を用いた。また、電圧-輝度測定を行ったところ、8 Vで2900 cd/m²の輝度が得られた。

【0297】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200 cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで1100時間であった。

【0298】実施例40

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)-3のアミノスチリル化合物を正孔輸送性発光層として用いた有機電界発光素子を作製した例である。

【0299】まず、真空蒸着装置中に、100 nmの厚さのITOからなる陽極が一表面に形成された30 mm×30 mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0 mm×2.0 mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により10⁻⁴ Pa以下の真空下で上記構造式(15)-3のアミノスチリル化合物を例えば50 nmの厚さに正孔輸送層(兼発光層)として成膜した。蒸着レートは0.1 nm/秒とした。

【0300】さらに、ホールブロッキング層材料として上記構造式のバソクプロインを正孔輸送層に接して蒸着した。バソクプロインからなるこのホールブロッキング層の膜厚は例えば15 nmとし、蒸着レートは0.1 nm/秒とした。

【0301】さらに、電子輸送層材料として上記構造式のAlq₃(トリス(8-キノリノール)アルミニウム)をホールブロッキング層に接して蒸着した。Alq₃からなるこの電子輸送層の膜厚も例えば50 nmとし、蒸着レートは0.2 nm/秒とした。

【0302】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1 nm/秒として例えば50 nm (Mg膜) 及び150 nm (Ag膜) の厚さに形成し、実施例40による図7に示した如き有機電界発光素子を作製した。

【0303】このように作製した実施例40の有機電界

発光特性を評価した。発光色は赤色であり、分光測定を行った結果、640 nm付近に発光ピークを有するスペクトルを得た。分光測定は、大塚電子社製のフォトダイオードアレイを検出器とした分光器を用いた。また、電圧-輝度測定を行ったところ、8 Vで3000 cd/m²の輝度が得られた。

【0304】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200 cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで1100時間であった。

【0305】実施例41

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)-3のアミノスチリル化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0306】まず、真空蒸着装置中に、100 nmの厚さのITOからなる陽極が一表面に形成された30 mm×30 mmのガラス基板をセッティングした。蒸着マスクとして複数の2.0 mm×2.0 mmの単位開口を有する金属マスクを基板に近接して配置し、真空蒸着法により10⁻⁴ Pa以下の真空下で下記構造式のα-NPDを例えば30 nmの厚さに成膜した。蒸着レートは0.1 nm/秒とした。

【0307】さらに、上記構造式(15)-3の化合物を正孔輸送層に接して蒸着した。上記構造式(15)-3の化合物からなる電子輸送層(兼発光層)の膜厚も例えば30 nmとし、蒸着レートは0.2 nm/秒とした。

【0308】さらに、ホールブロッキング層材料として上記構造式のバソクプロインを発光層に接して蒸着した。バソクプロインからなるこのホールブロッキング層の膜厚は例えば15 nmとし、蒸着レートは0.1 nm/秒とした。

【0309】さらに、電子輸送層材料として上記構造式のAlq₃をホールブロッキング層に接して蒸着した。Alq₃からなるこの電子輸送層の膜厚も例えば30 nmとし、蒸着レートは0.2 nm/秒とした。

【0310】陰極材料としてはMgとAgの積層膜を採用し、これも蒸着により、蒸着レート1 nm/秒として例えば50 nm (Mg) 及び150 nm (Ag膜) の厚さに形成し、図9に示した如き有機電界発光素子を作製した。

【0311】このように作製した実施例41の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例40と同様に分光測定を行った結果、640 nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8 Vで3800 cd/m²の輝度

【0312】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで1500時間であった。

【0313】実施例42

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)-2のアミノスチリル化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0314】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0315】このように作製した実施例42の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は橙色であり、実施例40と同様に分光測定を行った結果、600nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで 1200 cd/m^2 の輝度が得られた。

【0316】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで800時間であった。

【0317】実施例43

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)-4のアミノスチリル化合物を電子輸送性発光層としてた有機電界発光素子を作製した例である。

【0318】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0319】このように作製した実施例43の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例40と同様に分光測定を行った結果、620nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで 1100 cd/m^2 の輝度が得られた。

【0320】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで600時間であった。

【0321】実施例44

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)-6の化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0322】層構造、成膜法とも実施例41に準拠して

【0323】このように作製した実施例44の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は橙色であり、実施例40と同様に分光測定を行った結果、595nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで 700 cd/m^2 の輝度が得られた。

【0324】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで300時間であった。

【0325】実施例45

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)-7のアミノスチリル化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0326】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0327】このように作製した実施例45の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例40と同様に分光測定を行った結果、620nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで 750 cd/m^2 の輝度が得られた。

【0328】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで450時間であった。

【0329】実施例46

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)-8のアミノスチリル化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0330】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0331】このように作製した実施例46の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例40と同様に分光測定を行った結果、620nm付近に発光ピークを有するスペクトルを得た。また、電圧-輝度測定を行ったところ、8Vで 520 cd/m^2 の輝度が得られた。

【0332】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度 200 cd/m^2 で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減す

【0333】実施例47

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－9のアミノスチリル化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0334】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0335】このように作製した実施例47の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例40と同様に分光測定を行った結果、650nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで1000cd/m²の輝度が得られた。

【0336】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで600時間であった。

【0337】実施例48

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－11のアミノスチリル化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0338】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0339】このように作製した実施例48の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は橙色であり、実施例40と同様に分光測定を行った結果、590nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで1200cd/m²の輝度が得られた。

【0340】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで850時間であった。

【0341】実施例49

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－12のアミノスチリル化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0342】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0343】このように作製した実施例49の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例40と同様に分光測定を行った結果、610nm付近に発

測定を行ったところ、8Vで930cd/m²の輝度が得られた。

【0344】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで700時間であった。

【0345】実施例50

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(17)－1のアミノスチリル化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0346】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0347】このように作製した実施例50の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例40と同様に分光測定を行った結果、630nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで1700cd/m²の輝度が得られた。

【0348】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで1000時間であった。

【0349】実施例51

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(17)－2の化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0350】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0351】このように作製した実施例51の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例40と同様に分光測定を行った結果、655nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで1400cd/m²の輝度が得られた。

【0352】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで850時間であった。

【0353】実施例52

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(17)－3の化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例であ

【0354】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0355】このように作製した実施例52の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例40と同様に分光測定を行った結果、600nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで900cd/m²の輝度が得られた。

【0356】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで650時間であった。

【0357】実施例53

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(17)－4の化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0358】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0359】このように作製した実施例53の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例40と同様に分光測定を行った結果、630nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで1300cd/m²の輝度が得られた。

【0360】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで750時間であった。

【0361】実施例54

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(17)－5の化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0362】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0363】このように作製した実施例54の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例40と同様に分光測定を行った結果、660nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで800cd/m²の輝度が得られた。

【0364】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかつ

通電して連続発光し、強制劣化させた際、輝度が半減するまで500時間であった。

【0365】実施例55

本実施例は、上述の一般式[I]のアミノスチリル化合物のうち、上記構造式(15)－5のアミノスチリル化合物を電子輸送性発光層として用いた有機電界発光素子を作製した例である。

【0366】層構造、成膜法とも実施例41に準拠して有機電界発光素子を作製した。

【0367】このように作製した実施例55の有機電界発光素子に、窒素雰囲気下で順バイアス直流電圧を加えて発光特性を評価した。発光色は赤色であり、実施例40と同様に分光測定を行った結果、660nm付近に発光ピークを有するスペクトルを得た。また、電圧－輝度測定を行ったところ、8Vで1700cd/m²の輝度が得られた。

【0368】この有機電界発光素子を作製後、窒素雰囲気下に1カ月間放置したが、素子劣化は観察されなかった。また、初期輝度200cd/m²で電流値を一定に通電して連続発光し、強制劣化させた際、輝度が半減するまで900時間であった。

【0369】

【発明の作用効果】本発明の有機電界発光素子によれば、発光領域を有する有機層が陽極と陰極との間に設けられている有機電界発光素子において、前記有機層の構成層の少なくとも1層に前記一般式[I]で表されるアミノスチリル化合物の少なくとも1種が混合物として又は単独に含まれているので、この特定のアミノスチリル化合物及び／又はこれに効率良くエネルギーを伝達することが可能な材料から発光領域を構成でき、高い蛍光収率で熱安定性に優れ、赤色純度が良く、高輝度、高信頼性の赤色発光素子を提供できる。

【0370】しかも、前記ホールブロッキング層を設けることによって、本来高い量子収率を有する上記アミノスチリル化合物を含有する有機電界発光素子において、発光層でのホールと電子の再結合を促進し、さらに高輝度かつ高効率な発光を呈する有機電界発光素子を提供することができる。

【図面の簡単な説明】

【図1】本発明に基づく有機電界発光素子の要部概略断面図である。

【図2】同、有機電界発光素子の他の例の要部概略断面図である。

【図3】同、有機電界発光素子の他の例の要部概略断面図である。

【図4】同、有機電界発光素子の他の例の要部概略断面図である。

【図5】同、有機電界発光素子の他の例の要部概略断面図である。

図である。

【図 7】 同、有機電界発光素子の他の例の要部概略断面図である。

【図 8】 同、有機電界発光素子の他の例の要部概略断面図である。

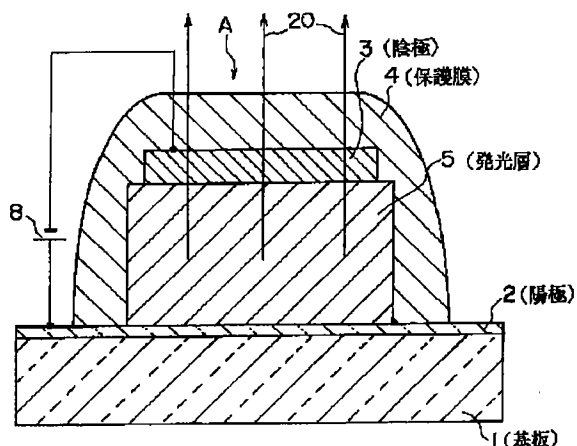
【図 9】 同、有機電界発光素子の更に他の例の要部概略断面図である。

【図 10】 同、有機電界発光素子を用いたフルカラーの平面ディスプレイの構成図である。

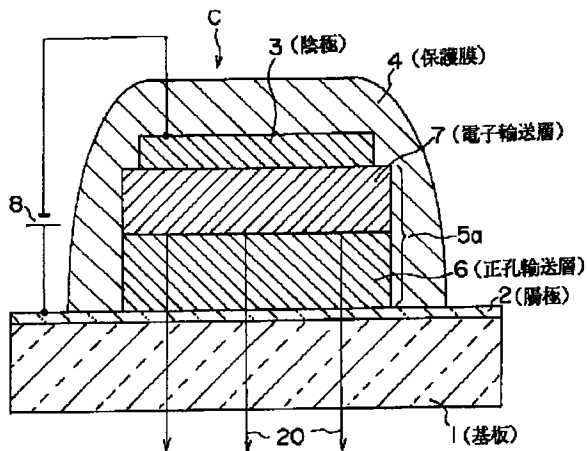
【符号の説明】

1…基板、2…透明電極（陽極）、3…陰極、4…保護膜、5、5 a、5 b…有機層、6…正孔輸送層、7…電子輸送層、8…電源、10…正孔輸送層、11…発光層、12…電子輸送層、14…輝度信号回路、15…制御回路、20…発光光、30…ホールブロッキング層、A、B、C、D、A'、B'、C'、D'…有機電界発光素子

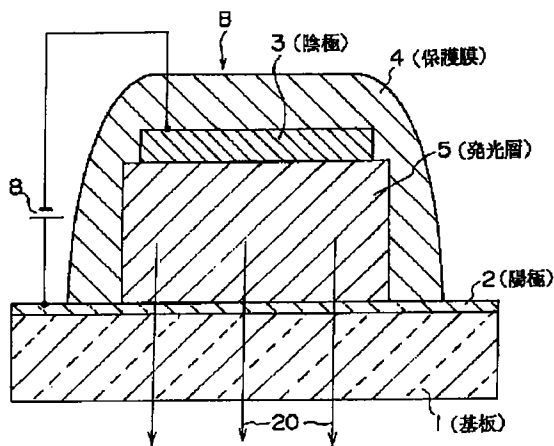
【図 1】



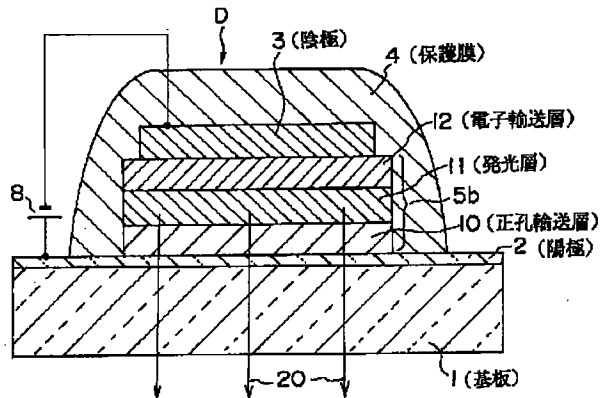
【図 3】



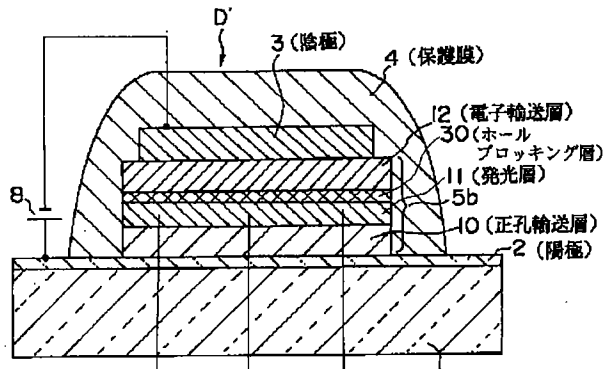
【図 2】



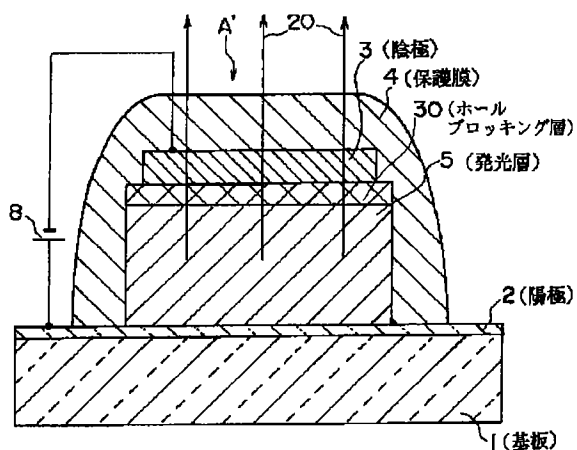
【図 4】



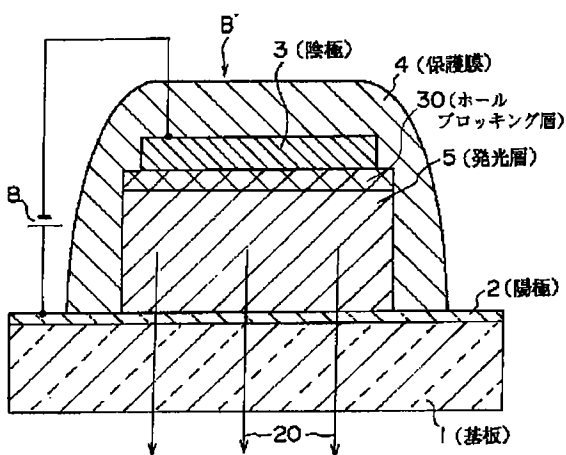
【図 9】



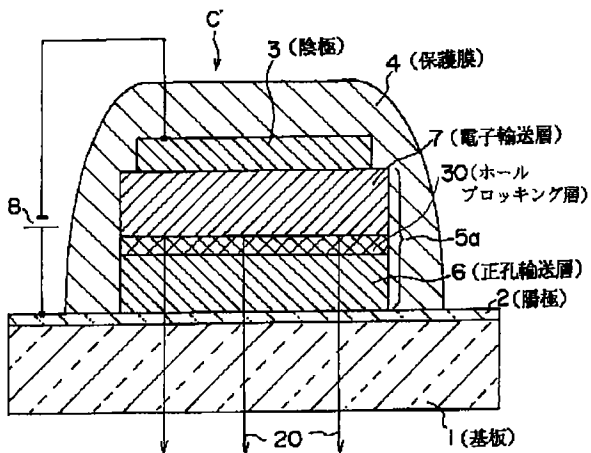
【図5】



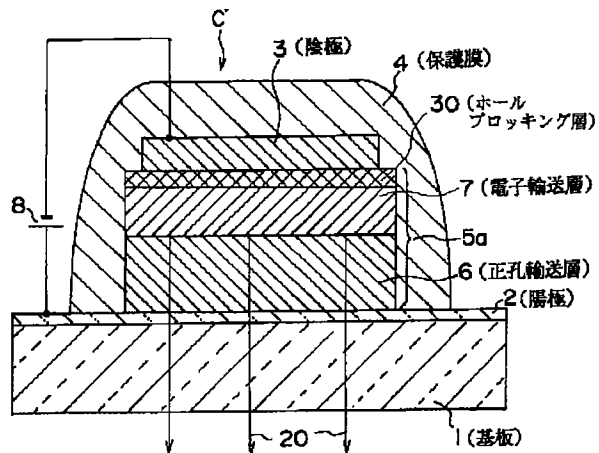
【図6】



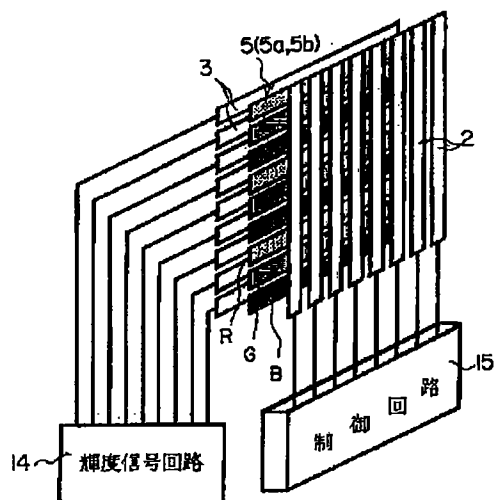
【図7】



【図8】



【図10】



フロントページの続き

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	6 4 5		6 4 5
	6 5 0		6 5 0
H O 5 B 33/22		H O 5 B 33/22	B
			D

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CA01 CB01 DA01 DB03 EA00
EB00
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H05B 33/22

(21)Application number : 2000-106430 (71)Applicant : SONY CORP

(22)Date of filing : 07.04.2000 (72)Inventor : ISHIBASHI TADASHI

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(54) ORGANIC ELECTROLUMINESCENT ELEMENT AND LUMINESCENT
DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an organic electroluminescent element to emit a red light which has a high red color purity and a high brightness and stability by using a compound which has a high fluorescent yield, and which is also superior in a thermal stability.

SOLUTION: This is the organic electric field luminescent element wherein an ITO transparent electrode 2, a hole transport layer 6, an electron transport layer

7 and a metal-electrode 3 are laminated in this order, and the hole transport layer 6 and/or the electron transport 7 is composed of the mixture layer containing at least one kind of amino styryl compound expressed in formula [I], and further, wherein a hole blocking layer 30 is installed between the hole transport layer 6 and the electron transport layer 7. In formula [I], X1 is an aryl group such as a phenyl group that has a substituent like nitro group, and Y1 and Y2 are groups that have aminophenyl group or the like in a skeleton.

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[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

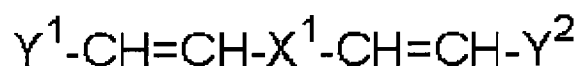
CLAIMS

[Claim(s)]

[Claim 1] Organic electroluminescence devices characterized by consisting of a mixture layer in which at least one of the configuration layers of said organic layer contained at least one sort of an amino styryl compound expressed with the following general formula [I] in the organic electroluminescence devices by which the organic layer which has a luminescence field is prepared between an anode plate and cathode.

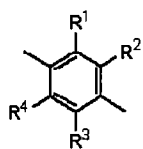
[Formula 1]

一般式 [I] :

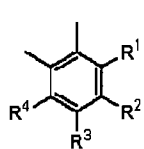


It is the radical as which X1 is expressed in either of following general formula (1)

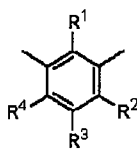
- (7) in [, however said general formula [I], and is [Formula 2].



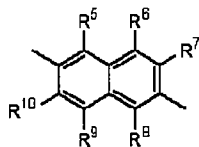
(1)



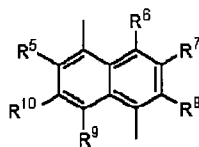
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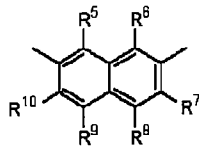
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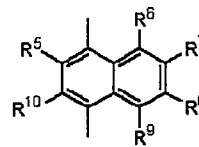
(4)



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(6)

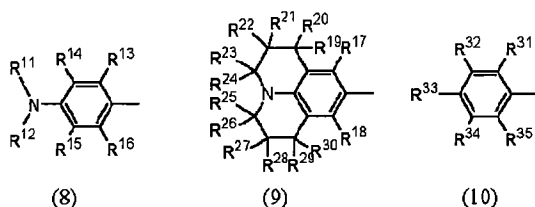


(7)

however, said general formula (1) - (3) -- setting -- the inside of R1-R4 -- at least one -- a halogen atom -- It is the radical chosen from the nitro group, the cyano group, and the fluoro alkyl group. Others A hydrogen atom, an alkyl group, an aryl group, an alkoxy group, a halogen atom, Are the radical chosen from the nitro group, the cyano group, and the fluoro alkyl group, even if they are the same, may differ, and it sets to said general formula (4) - (7). At least one of R5-R10 is the radical chosen from the halogen atom, the nitro group, the cyano group, and the fluoro alkyl group. others are the radicals chosen from a hydrogen atom, an alkyl group, an aryl group, an alkoxy group, the halogen atom,

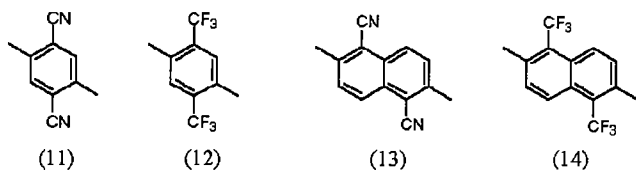
the nitro group, the cyano group, and the fluoro alkyl group, and even if they are the same, they may differ. Moreover, Y1 is a radical expressed with the following general formula (8) or (9), and Y2 is a radical expressed with the following general formula (8), (9), or (10).

[Formula 3]

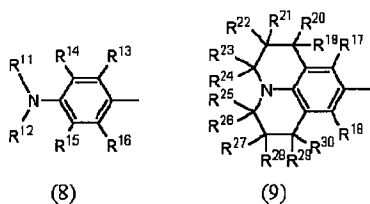


however, said general formula (8) - (10) -- setting -- R¹¹ and R¹² -- a hydrogen atom -- It is the radical chosen from the aryl group which may have the alkyl group which may have a substituent, and a substituent. You may differ, even if they are the same. R¹³-R³⁵ A hydrogen atom, it is the radical chosen from the alkyl group which may have a substituent, the aryl group which may have a substituent, the alkoxy group which may have a substituent, the halogen atom, the nitro group, the cyano group, and the fluoro alkyl group, and even if they are the same, you may differ.]

[Claim 2] It is the radical as which X¹ is expressed in either of following structure-expression (11) - (14) in said general formula [I], and is [Formula 4].



Moreover, Y1 and Y2 are [Formula 5] which is the radical expressed with the following general formula (8) or (9).



In (said general formula (8 [however,])) and (9), although R11 and R12 are the same as the above mentioned thing and R13-R30 are the same as the above mentioned thing, in the case of a fluoro alkyl group, it is a trifluoromethyl radical.), organic electroluminescence devices indicated to claim 1.

[Claim 3] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and consist of said mixture layer containing at least one sort of the amino styryl compound of said organic laminated structures to which said electron transport layer is expressed with said general formula [I] at least and which were indicated to claim 1.

[Claim 4] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and consist of said mixture layer containing at least one sort of the amino styryl compound of said organic laminated structures to which said hole transportation layer is expressed with said general formula [I] at least and which were indicated to claim 1.

[Claim 5] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and said hole transportation layer becomes from said mixture layer containing at least one sort of an amino styryl compound expressed with said general formula [I], and said electron transport layer becomes from said mixture layer containing at least one sort of an amino styryl compound expressed with said general formula [I] and which were indicated to claim 1.

[Claim 6] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and consist of said mixture layer containing at least one sort of the amino styryl compound of said organic laminated structures by which said

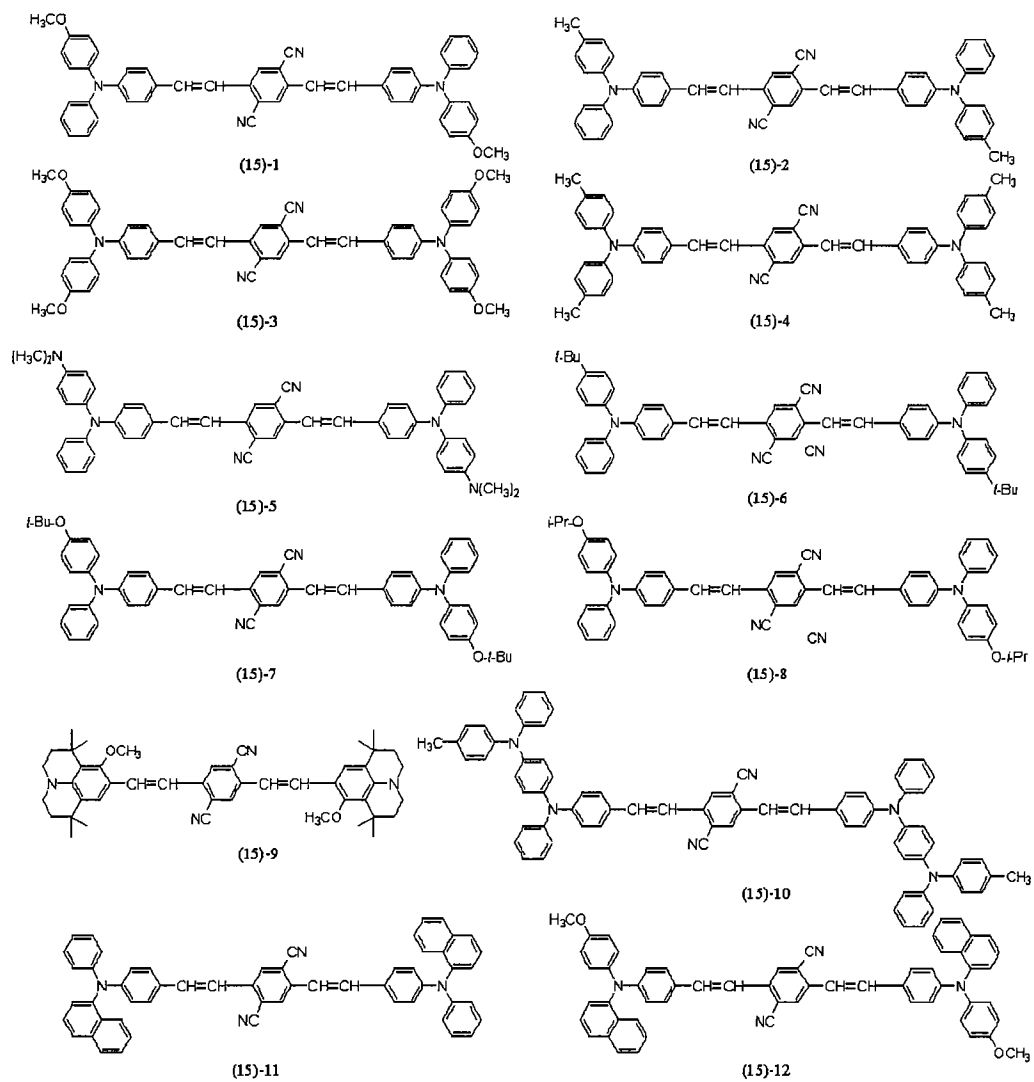
luminous layer is expressed at least with said general formula [I] and which were indicated to claim 1.

[Claim 7] Luminescence equipment using the organic electroluminescence devices indicated in any 1 term of claims 1-6.

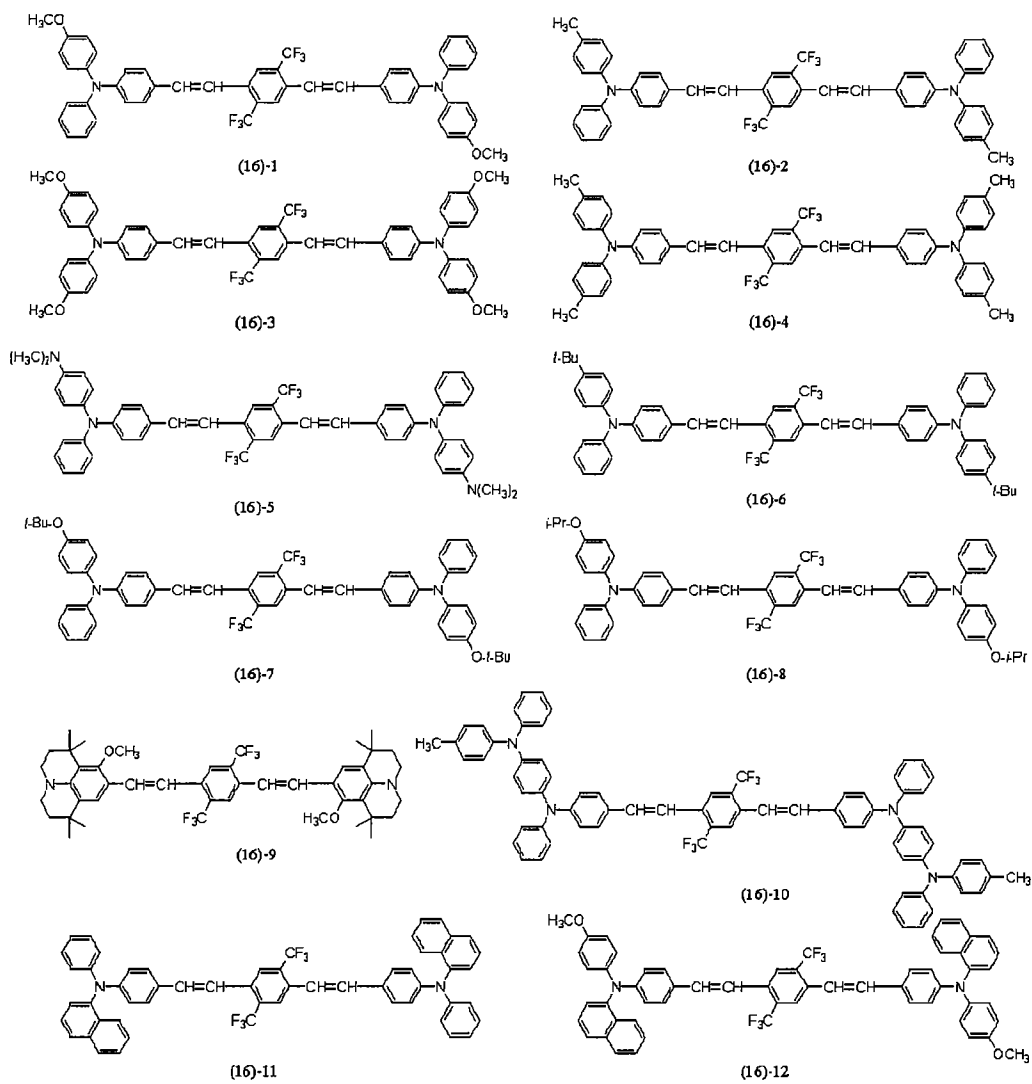
[Claim 8] Luminescence equipment which was constituted as a display device and which was indicated to claim 7.

[Claim 9] In the organic electroluminescence devices by which the organic layer which has a luminescence field is prepared between an anode plate and cathode At least one of the configuration layers of said organic layer Following structure-expression (15)-1- (15) Organic electroluminescence devices characterized by consisting of a mixture layer containing at least one sort of an amino styryl compound expressed with -12, (16)-1-(16)-12, (17)-1-(17)-6, and (18)-1-(18)-6.

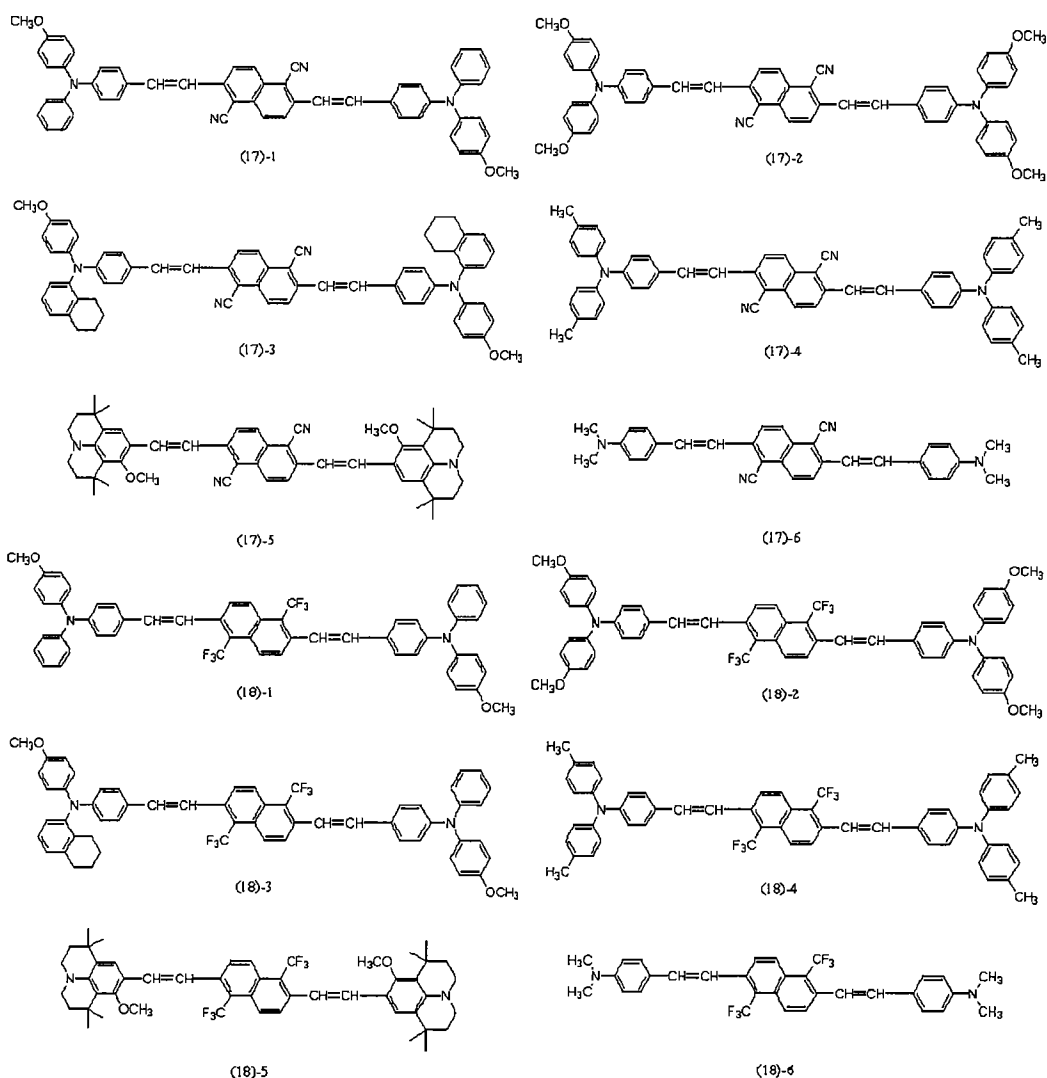
[Formula 6]



[Formula 7]



[Formula 8]



[Claim 10] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and consist of said mixture layer of said organic laminated structures with which the electron transport layer contained at least one sort of said amino styryl compound at least and which were indicated to claim 9.

[Claim 11] Organic electroluminescence devices which said organic layer is

making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and consist of said mixture layer of said organic laminated structures with which the hole transportation layer contained at least one sort of said amino styryl compound at least and which were indicated to claim 9.

[Claim 12] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and said hole transportation layer becomes from said mixture layer containing at least one sort of said amino styryl compound, and said electron transport layer becomes from said mixture layer containing at least one sort of said amino styryl compound and which were indicated to claim 9.

[Claim 13] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and becomes from said mixture layer of said organic laminated structures in which the luminous layer contained at least one sort of said amino styryl compound at least and which were indicated to claim 9.

[Claim 14] Organic electroluminescence devices which consist of said mixture layer in which said at least one of the configuration layers of said organic layer

contained at least one sort of said amino styryl compound, and the red luminescence coloring matter which has the luminescence maximum in the range of 600nm or more and which were indicated to claim 9.

[Claim 15] Organic electroluminescence devices said at least one [whose] of the configuration layers of said organic layer said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and is said electron transport layer at least and which were indicated to claim 14.

[Claim 16] Organic electroluminescence devices said at least one [whose] of the configuration layers of said organic layer said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and is said hole transportation layer at least and which were indicated to claim 14.

[Claim 17] Said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out. Said hole transportation layer At least one sort of said amino styryl compound, It consists of said mixture layer containing the red luminescence coloring matter which has the luminescence maximum in the range of 600nm or more. Said electron transport layer At least one sort of said amino styryl compound, Organic electroluminescence devices which consist of said mixture

layer containing the red luminescence coloring matter which has the luminescence maximum in the range of 600nm or more and which were indicated to claim 9.

[Claim 18] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and consist of said mixture layer containing the red luminescence coloring matter of said organic laminated structures with which said luminous layer has the luminescence maximum at least in at least one sort of said amino styryl compound, and the range of 600nm or more and which were indicated to claim 9.

[Claim 19] Luminescence equipment using the organic electroluminescence devices indicated in any 1 term of claims 9-18.

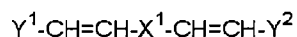
[Claim 20] Luminescence equipment which was constituted as a display device and which was indicated to claim 19.

[Claim 21] Organic electroluminescence devices characterized by consisting of a luminescent mixture layer in which at least one of the configuration layers of said organic layer contained at least one sort of an amino styryl compound expressed with the following general formula [I] in the organic electroluminescence devices by which the organic layer which has a luminescence field is prepared between

an anode plate and cathode, and a hole blocking layer existing in the cathode side of said luminescent mixture layer.

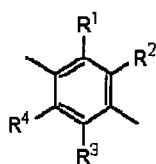
[Formula 9]

一般式 [I] :

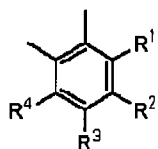


It is the radical as which X1 is expressed in either of following general formula (1)

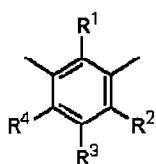
- (7) in [, however said general formula [I], and is [Formula 10].



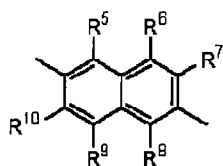
(1)



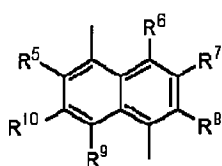
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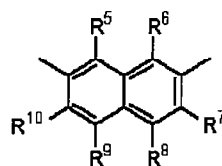
(3)



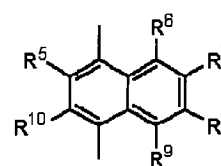
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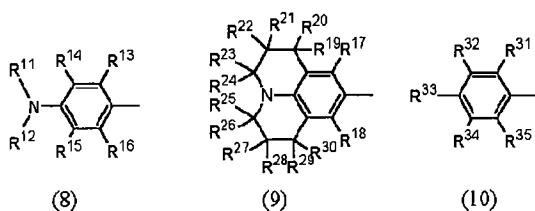


(7)

however, said general formula (1) - (3) -- setting -- the inside of R1-R4 -- at least one -- a halogen atom -- It is the radical chosen from the nitro group, the cyano group, and the fluoro alkyl group. Others A hydrogen atom, an alkyl group, an aryl group, an alkoxy group, a halogen atom, Are the radical chosen from the nitro group, the cyano group, and the fluoro alkyl group, even if they are the same, may differ, and it sets to said general formula (4) - (7). At least one of

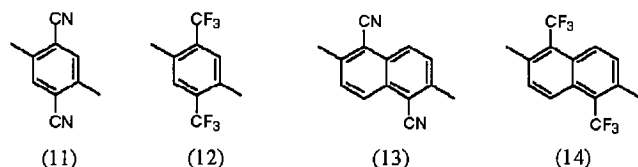
R5-R10 is the radical chosen from the halogen atom, the nitro group, the cyano group, and the fluoro alkyl group. others are the radicals chosen from a hydrogen atom, an alkyl group, an aryl group, an alkoxy group, the halogen atom, the nitro group, the cyano group, and the fluoro alkyl group, and even if they are the same, they may differ. Moreover, Y1 is a radical expressed with the following general formula (8) or (9), and Y2 is a radical expressed with the following general formula (8), (9), or (10).

[Formula 11]

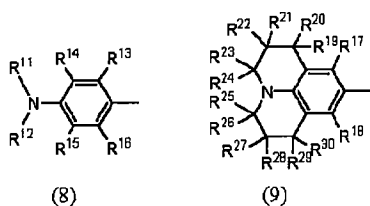


however, said general formula (8) - (10) -- setting -- R¹¹ and R¹² -- a hydrogen atom -- It is the radical chosen from the aryl group which may have the alkyl group which may have a substituent, and a substituent. You may differ, even if they are the same. R¹³-R³⁵ A hydrogen atom, it is the radical chosen from the alkyl group which may have a substituent, the aryl group which may have a substituent, the alkoxy group which may have a substituent, the halogen atom, the nitro group, the cyano group, and the fluoro alkyl group, and even if they are the same, you may differ.]

[Claim 22] It is the radical as which X1 is expressed in either of following structure-expression (11) - (14) in said general formula [I], and is [Formula 12].



Moreover, Y1 and Y2 are [Formula 13] which is the radical expressed with the following general formula (8) or (9).



In (said general formula (8 [however,])) and (9), although R11 and R12 are the same as the above mentioned thing and R13-R30 are the same as the above mentioned thing, in the case of a fluoro alkyl group, it is a trifluoromethyl radical.), organic electroluminescence devices indicated to claim 21.

[Claim 23] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and consist of said luminescent mixture layer containing at least one sort of the amino styryl compound of said organic laminated structures to which said electron transport

layer is expressed with said general formula [I] at least and which were indicated to claim 21.

[Claim 24] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and consist of said luminescent mixture layer containing at least one sort of the amino styryl compound of said organic laminated structures to which said hole transportation layer is expressed with said general formula [I] at least and which were indicated to claim 21.

[Claim 25] Said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out. Said hole transportation layer consists of said luminescent mixture layer containing at least one sort of an amino styryl compound expressed with said general formula [I]. Organic electroluminescence devices to which said electron transport layer consists of said luminescent mixture layer containing at least one sort of an amino styryl compound expressed with said general formula [I], and said hole blocking layer exists in the cathode side of the luminescent mixture layer of the electronic transportability of a parenthesis and which were indicated to claim 21.

[Claim 26] Organic electroluminescence devices which said organic layer is

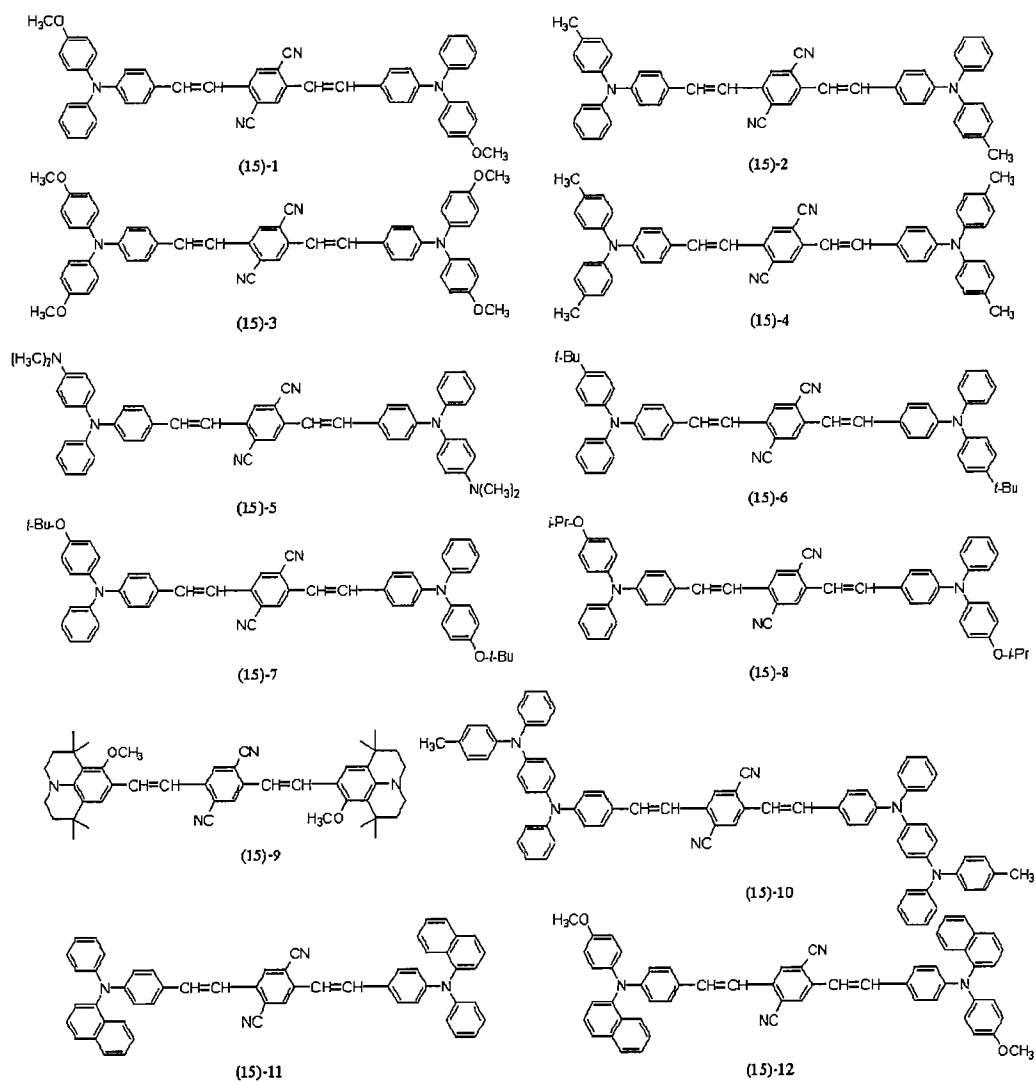
making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and consist of said luminescent mixture layer containing at least one sort of the amino styryl compound of said organic laminated structures by which said luminous layer is expressed at least with said general formula [I] and which were indicated to claim 21.

[Claim 27] Luminescence equipment using the organic electroluminescence devices indicated in any 1 term of claims 21-26.

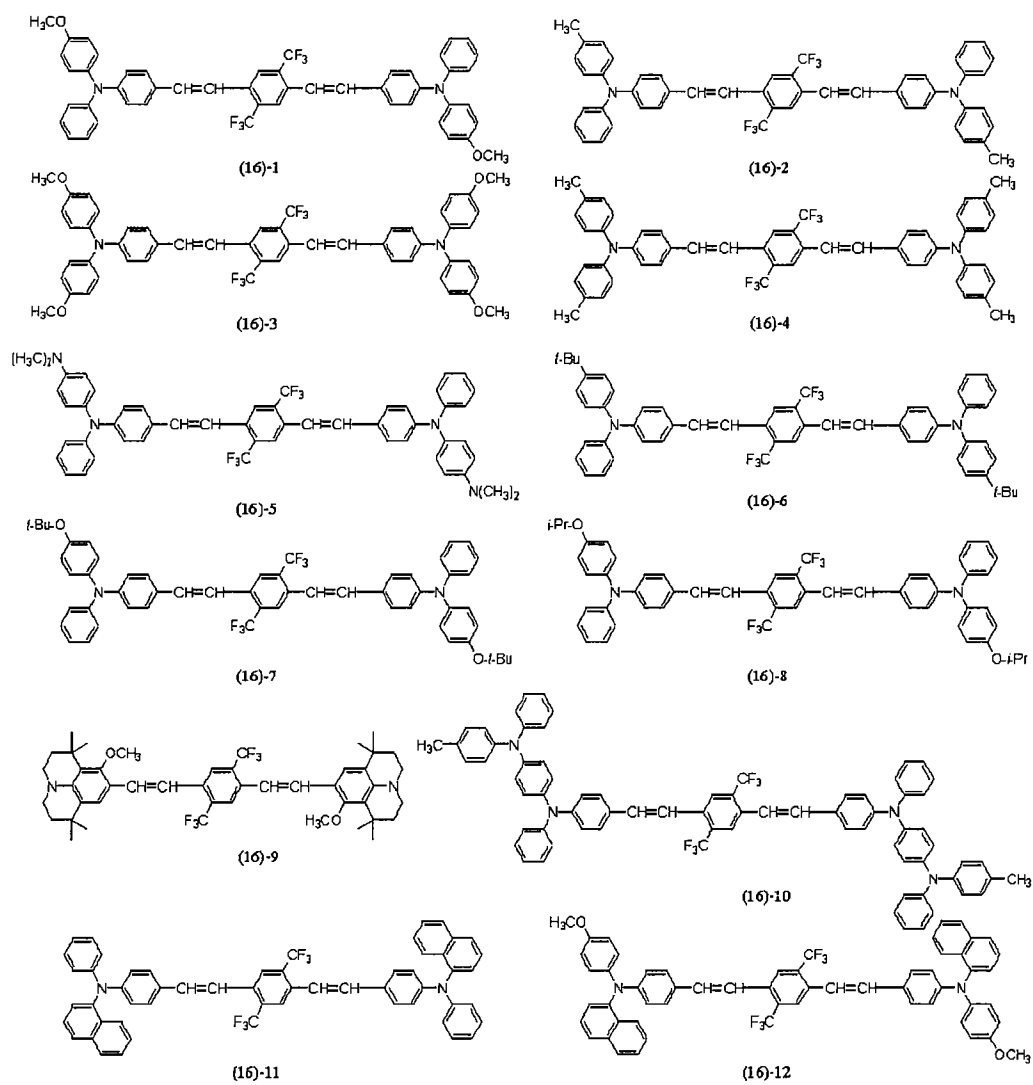
[Claim 28] Luminescence equipment which was constituted as a display device and which was indicated to claim 27.

[Claim 29] In the organic electroluminescence devices by which the organic layer which has a luminescence field is prepared between an anode plate and cathode At least one of the configuration layers of said organic layer Following structure-expression (15)-1- (15) It consists of a luminescent mixture layer containing at least one sort of an amino styryl compound expressed with -12, (16)-1-(16)-12, (17)-1-(17)-6, and (18)-1-(18)-6. And organic electroluminescence devices characterized by a hole blocking layer existing in the cathode side of said luminescent mixture layer.

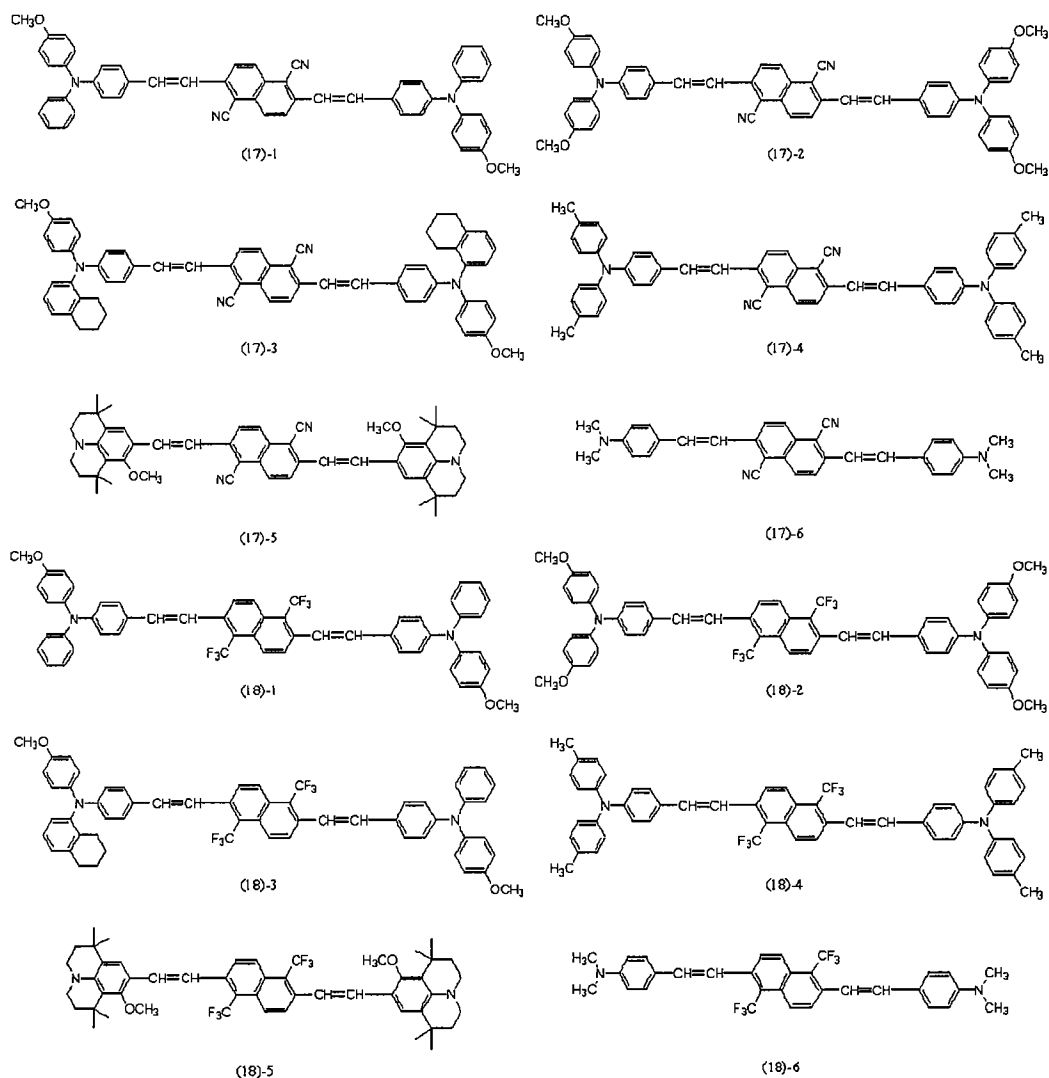
[Formula 14]



[Formula 15]



[Formula 16]



[Claim 30] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and consist of said luminescent mixture layer of said organic laminated structures with which the electron transport layer contained at least one sort of said amino styryl compound at least and which were indicated to claim 29.

[Claim 31] Organic electroluminescence devices which said organic layer is

making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and consist of said luminescent mixture layer of said organic laminated structures with which the hole transportation layer contained at least one sort of said amino styryl compound at least and which were indicated to claim 29.

[Claim 32] Said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out. Said hole transportation layer consists of said luminescent mixture layer containing at least one sort of said amino styryl compound. Organic electroluminescence devices to which said electron transport layer consists of said luminescent mixture layer containing at least one sort of said amino styryl compound, and said hole blocking layer exists in the cathode side of the luminescent mixture layer of the electronic transportability of a parenthesis and which were indicated to claim 29.

[Claim 33] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and becomes from said luminescent mixture layer of said organic laminated structures in which the luminous layer contained at least one sort of said amino styryl compound at least and which were indicated to claim 29.

[Claim 34] Organic electroluminescence devices which consist of said luminescent mixture layer in which said at least one of the configuration layers of said organic layer contained at least one sort of said amino styryl compound, and the red luminescence coloring matter which has the luminescence maximum in the range of 600nm or more and which were indicated to claim 29.

[Claim 35] Organic electroluminescence devices said at least one [whose] of the configuration layers of said organic layer said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and is said electron transport layer at least and which were indicated to claim 34.

[Claim 36] Organic electroluminescence devices said at least one [whose] of the configuration layers of said organic layer said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and is said hole transportation layer at least and which were indicated to claim 34.

[Claim 37] Said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out. Said hole transportation layer At least one sort of said amino styryl compound, It consists of said luminescent mixture layer containing the red luminescence coloring matter which has the luminescence maximum in the

range of 600nm or more. Said electron transport layer At least one sort of said amino styryl compound, Organic electroluminescence devices to which it consists of said luminescent mixture layer containing the red luminescence coloring matter which has the luminescence maximum in the range of 600nm or more, and said hole blocking layer exists in the cathode side of the luminescent mixture layer of the electronic transportability of a parenthesis and which were indicated to claim 29.

[Claim 38] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and consist of said luminescent mixture layer containing the red luminescence coloring matter of said organic laminated structures with which said luminous layer has the luminescence maximum at least in at least one sort of said amino styryl compound, and the range of 600nm or more and which were indicated to claim 29.

[Claim 39] Luminescence equipment using the organic electroluminescence devices indicated in any 1 term of claims 29-38.

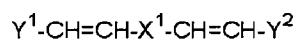
[Claim 40] Luminescence equipment which was constituted as a display device and which was indicated to claim 39.

[Claim 41] Organic electroluminescence devices characterized by for at least

one of the configuration layers of said organic layer consisting of an amino styryl compound layer which consisted of amino styryl compounds expressed with the following general formula [I] in the organic electroluminescence devices by which the organic layer which has a luminescence field is prepared between an anode plate and cathode, and a hole blocking layer existing in the cathode side of said amino styryl compound layer.

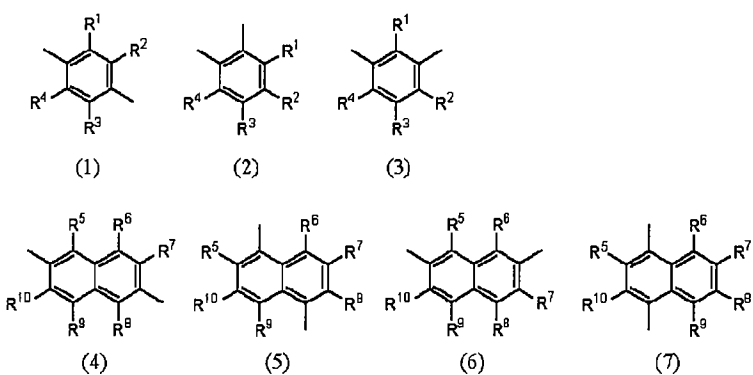
[Formula 17]

一般式 [I] :



It is the radical as which X1 is expressed in either of following general formula (1)

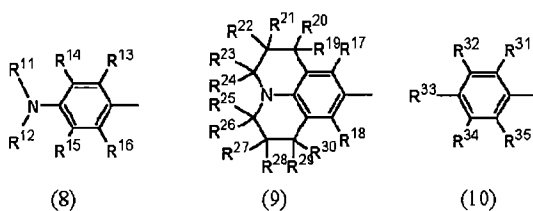
- (7) in [, however said general formula [I], and is [Formula 18].



however, said general formula (1) - (3) -- setting -- the inside of R1-R4 -- at least one -- a halogen atom -- It is the radical chosen from the nitro group, the cyano group, and the fluoro alkyl group. Others A hydrogen atom, an alkyl group, an aryl group, an alkoxy group, a halogen atom, Are the radical chosen from the

nitro group, the cyano group, and the fluoro alkyl group, even if they are the same, may differ, and it sets to said general formula (4) - (7). At least one of R5-R10 is the radical chosen from the halogen atom, the nitro group, the cyano group, and the fluoro alkyl group. others are the radicals chosen from a hydrogen atom, an alkyl group, an aryl group, an alkoxy group, the halogen atom, the nitro group, the cyano group, and the fluoro alkyl group, and even if they are the same, they may differ. Moreover, Y1 is a radical expressed with the following general formula (8) or (9), and Y2 is a radical expressed with the following general formula (8), (9), or (10).

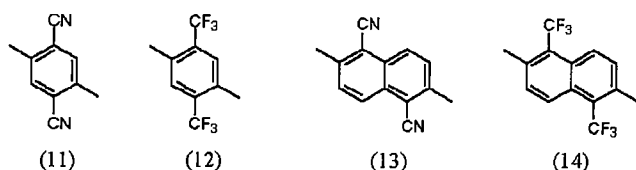
[Formula 19]



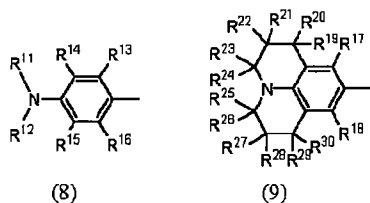
however, said general formula (8) - (10) -- setting -- R11 and R12 -- a hydrogen atom -- It is the radical chosen from the aryl group which may have the alkyl group which may have a substituent, and a substituent. You may differ, even if they are the same. R13-R35 A hydrogen atom, it is the radical chosen from the alkyl group which may have a substituent, the aryl group which may have a substituent, the alkoxy group which may have a substituent, the halogen atom,

the nitro group, the cyano group, and the fluoro alkyl group, and even if they are the same, you may differ.]

[Claim 42] It is the radical as which X1 is expressed in either of following structure-expression (11) - (14) in said general formula [I], and is [Formula 20].



Moreover, Y1 and Y2 are [Formula 21] which is the radical expressed with the following general formula (8) or (9).



In (said general formula (8 [however,]) and (9), although R11 and R12 are the same as the above mentioned thing and R13-R30 are the same as the above mentioned thing, in the case of a fluoro alkyl group, it is a trifluoromethyl radical.), organic electroluminescence devices indicated to claim 41.

[Claim 43] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and were

indicated to claim 41 of said organic laminated structures which said electron transport layer becomes from said amino styryl compound layer at least.

[Claim 44] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and were indicated to claim 41 of said organic laminated structures which said hole transportation layer becomes from said amino styryl compound layer at least.

[Claim 45] Organic electroluminescence devices to which said hole blocking layer exists in the cathode side of the amino styryl compound layer of the electronic transportability of a parenthesis by said organic layer's making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, said hole transportation layer's consisting of said amino styryl compound layer, and said electron transport layer consisting of said amino styryl compound layer and which were indicated to claim 41.

[Claim 46] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and were indicated at least to claim 41 of said organic laminated structures which said luminous layer becomes from said amino styryl compound

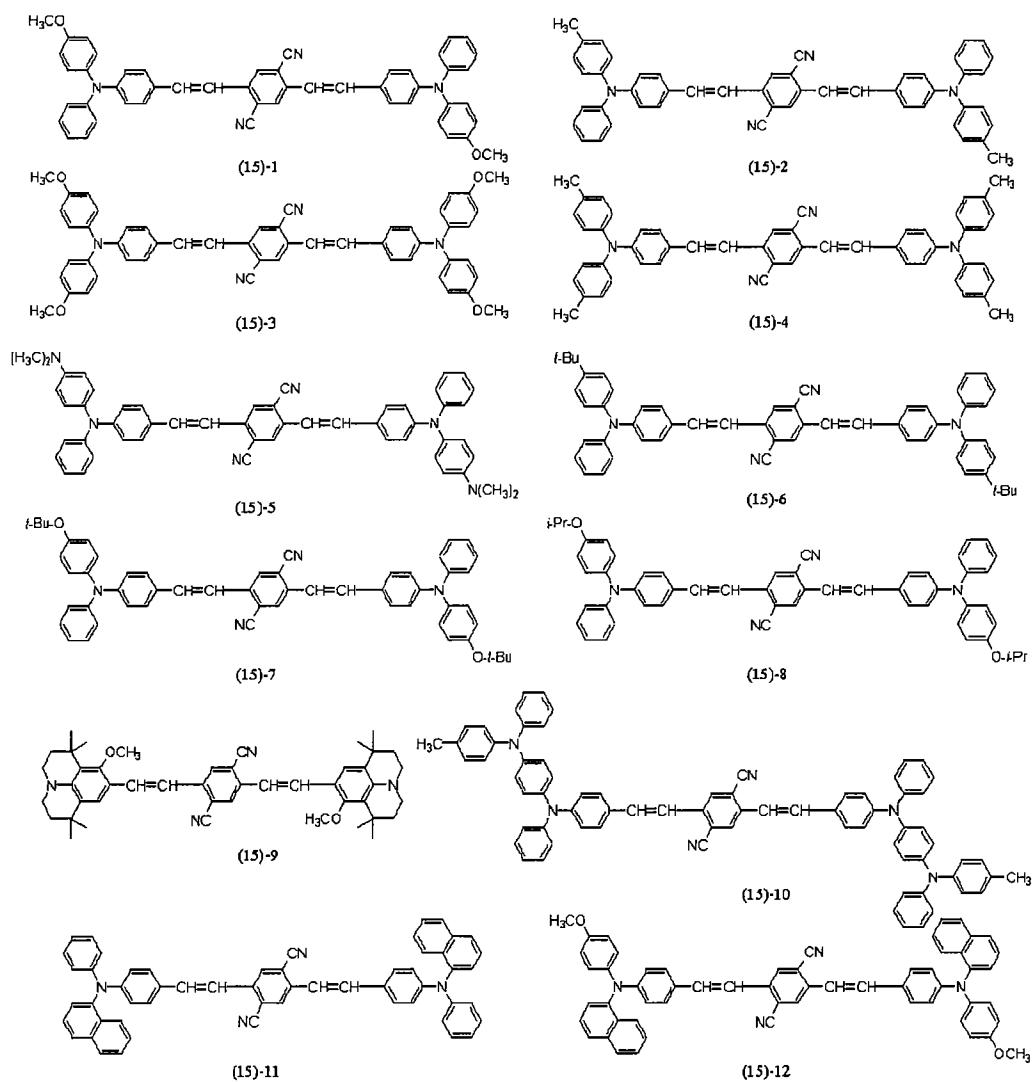
layer.

[Claim 47] Luminescence equipment using the organic electroluminescence devices indicated in any 1 term of claims 41-46.

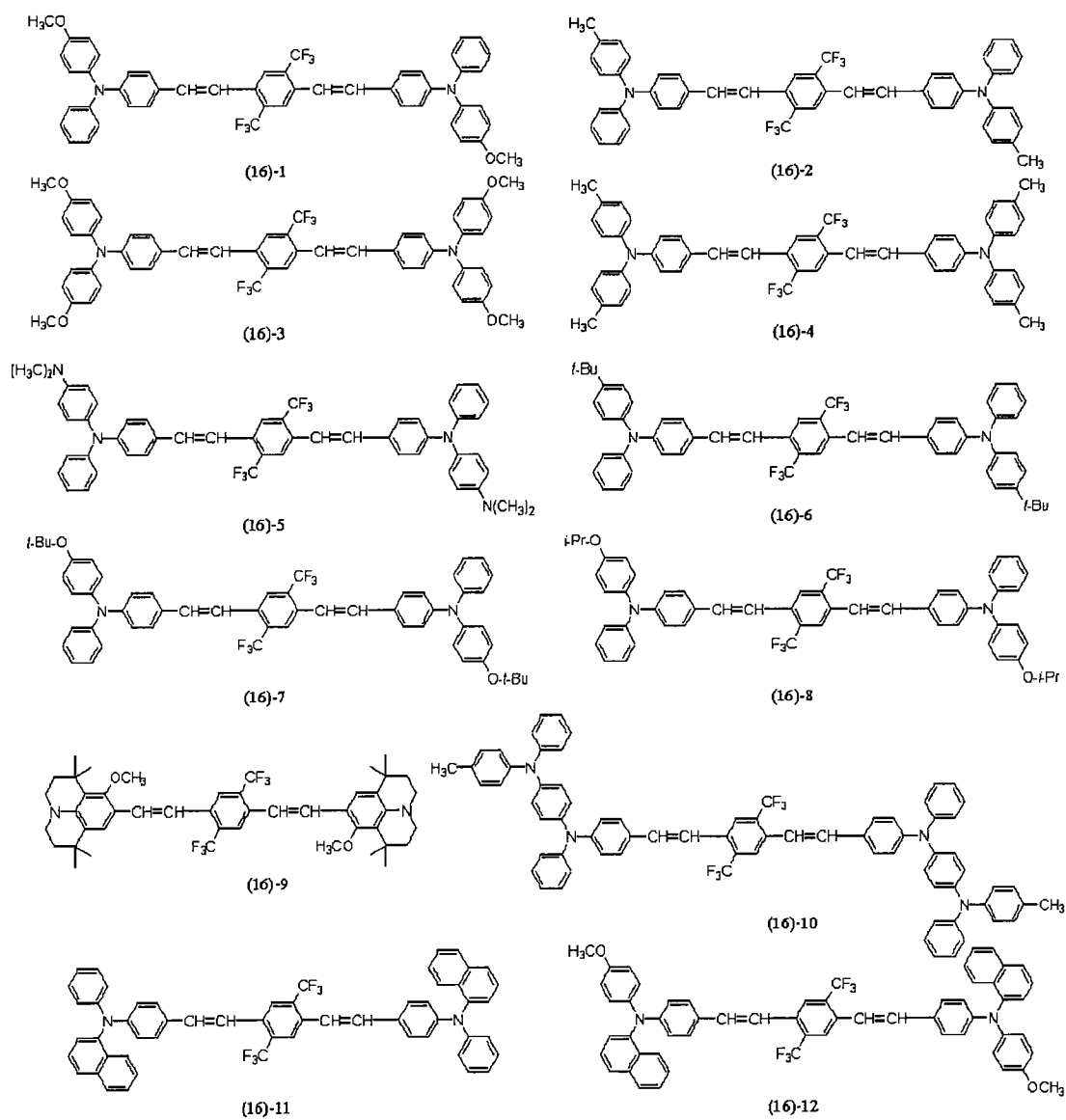
[Claim 48] Luminescence equipment which was constituted as a display device and which was indicated to claim 47.

[Claim 49] In the organic electroluminescence devices by which the organic layer which has a luminescence field is prepared between an anode plate and cathode At least one of the configuration layers of said organic layer Following structure-expression (15)-1- (15) It consists of an amino styryl compound layer which consisted of amino styryl compounds chosen from the amino styryl compound expressed with -12, (16)-1-(16)-12, (17)-1-(17)-6, and (18)-1-(18)-6. And organic electroluminescence devices characterized by a hole blocking layer existing in the cathode side of said amino styryl compound layer.

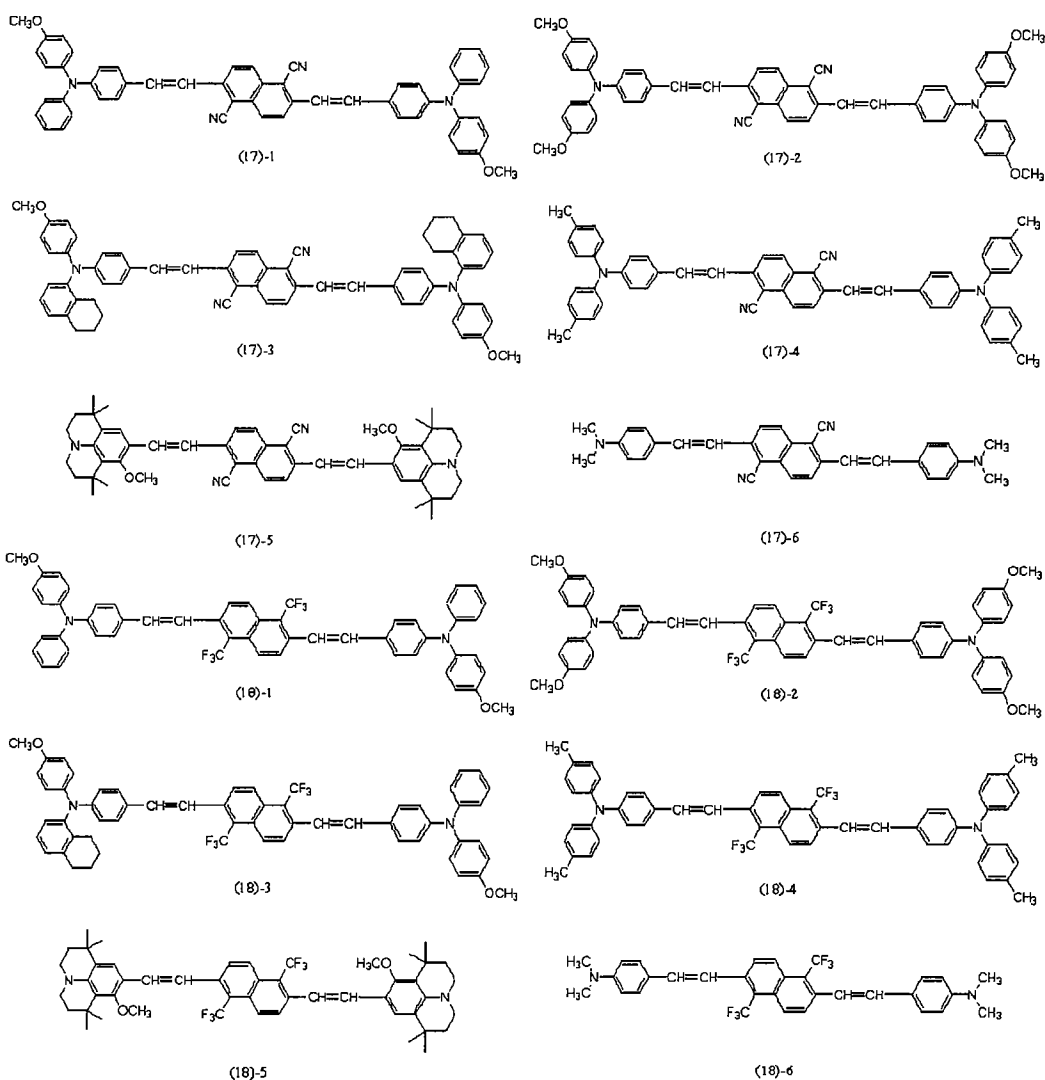
[Formula 22]



[Formula 23]



[Formula 24]



[Claim 50] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and were indicated to claim 49 of said organic laminated structures which an electron transport layer becomes from said amino styryl compound layer at least.

[Claim 51] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole

transportation layer and the electron transport layer was carried out, and were indicated to claim 49 of said organic laminated structures which a hole transportation layer becomes from said amino styryl compound layer at least.

[Claim 52] Organic electroluminescence devices to which said hole blocking layer exists in the cathode side of the amino styryl compound layer of the electronic transportability of a parenthesis by said organic layer's making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, said hole transportation layer's consisting of said amino styryl compound layer, and said electron transport layer consisting of said amino styryl compound layer and which were indicated to claim 49.

[Claim 53] Organic electroluminescence devices which said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and were indicated at least to claim 49 of said organic laminated structures which a luminous layer becomes from said amino styryl compound layer.

[Claim 54] Luminescence equipment using the organic electroluminescence devices indicated in any 1 term of claims 49-53.

[Claim 55] Luminescence equipment which was constituted as a display device

and which was indicated to claim 54.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to luminescence equipments, such as organic electroluminescence devices (organic EL device) by which the organic layer which has a luminescence field is prepared between an anode plate and cathode, and a display device using this.

[0002]

[Description of the Prior Art] The lightweight and efficient flat-panel display is briskly studied and developed as an object for the screen display of a computer or television.

[0003] first -- although brightness of the Braun tube (CRT) is high, and it is used most mostly as a current display since color reproduction nature is good -- ** -- it is high and power consumption also has heavily the problem of being high.

[0004] Moreover, as a lightweight and efficient flat-panel display, although liquid crystal displays, such as an active-matrix drive, are commercialized, the angle of

visibility of a liquid crystal display is narrow, and since it is not spontaneous light, it has the trouble of not having sufficient response engine performance to that the power consumption of a back light is large, and the high-speed video signal of a high definition with which utilization will be expected from now on under an environment dark in a perimeter. Technical problems, like especially the thing for which the display of big screen size is manufactured is difficult, and the cost is high also occur.

[0005] Although there is possibility of the display using the light emitting diode as an alternative over this, too, a manufacturing cost is high and the technical problem to utilization is large as a display candidate of a low price who there are problems, like it is difficult to form the matrix structure of a light emitting diode on the substrate whose number is one, and replaces the Braun tube.

[0006] Organic electroluminescence devices (organic EL device) using an organic luminescent material as a flat-panel display which may solve many of these technical problems attract attention recently. That is, by using an organic compound as a luminescent material, a speed of response is high-speed with spontaneous light, and implementation of a flat-panel display without an angle-of-visibility dependency is expected.

[0007] The configuration of organic electroluminescence devices forms the organic thin film containing the luminescent material which emits light by

impregnation of a current between the positive electrode of translucency, and metal cathode. C. W.Tang, S.A.VanSlyke, etc. In the research report of the 51st-volume No. 12 Applied Physics Letters 913-915-page (1987) printing The component structure which emits light when the hole and electron which were poured in into the organic film from each electrode recombine an organic thin film as two-layer structure of the thin film which consists of an electron hole transportability ingredient, and the thin film which consists of an electronic transportability ingredient was developed (organic EL device of single hetero structure).

[0008] With this component structure, either the electron hole transportation ingredient or the electronic transportation ingredient serves as luminescent material, and luminescence occurs by the wavelength range corresponding to the energy gap of the ground state and excitation state of luminescent material. By considering as such two-layer structure, reduction of large driver voltage and an improvement of luminous efficiency were made.

[0009] Then, C.Adachi, S.Tokita, T.Tsutsui, S.Saito etc. As indicated by the research report of Japanese Journal of Applied Physics volume [27th] No. 2 L269-L 271-page (1988) printing The three-tiered structure (organic EL device of double hetero structure) of an electron hole transportation ingredient, luminescent material, and an electronic transportation ingredient is developed.

Furthermore, C.W.Tang, S.A.VanSlyke, C.H.Chen, etc. Journal of Applied Physics As indicated by the research report of the 65th-volume No. 9 3610-3616-page (1989) printing The component structure where luminescent material was included in the electronic transportation ingredient etc. was developed. By these researches, by the low battery, the possibility of luminescence of high brightness is verified and researches and developments are done very actively in recent years.

[0010] It can be said that there is an organic compound used for luminescent material about the advantage that the luminescent color is theoretically changeable into arbitration by changing the molecular structure from the versatility. Therefore, it can be said to be easy by performing a molecular design compared with the thin film EL element which used the inorganic substance to arrange three good colors of R (red), G (green), and B (blue) of color purity required for a full color display.

[0011]

[Problem(s) to be Solved by the Invention] However, also in organic electroluminescence devices, there is a problem which must be solved in fact. As an electronic transportation ingredient by which is difficult for development of the stable red light emitting device of high brightness, and the current report is carried out tris (eight quinolinol) aluminum (the following, Alq₃, and an

abbreviated name --) Although there is an example (Chem.Funct.Dyes, Proc.Int.Symp., 2nd P.536 (1993)) of red luminescence which doped DCM [a 4-dicyanomethylene-6-(p-dimethylaminostyryl)-2-methyl-4H-pyran] etc.

Brightness and dependability are not satisfactory as a display ingredient.

[0012] Moreover, T.Tsutsui and D.U.Kim Inorganic and Organic electroluminescence BSB-BCN reported at the meeting (1996 Berlin) is 1000 cd/m². Although the above high brightness is realized, it cannot be said to be what has a perfect chromaticity as red which corresponds in full color.

[0013] The present condition is that implementation of stability and the high red light emitting device of color purity is furthermore desired by high brightness.

[0014] Moreover, in JP,7-188649,A (Japanese Patent Application No. No. 148798 [six to]), although it has proposed using a specific JISUCHIRIRU compound as an organic electroluminescence ingredient, the target luminescent color is blue and it is not an object for red.

[0015] The purpose of this invention is to offer the organic electroluminescence devices which have a high fluorescence yield, and red color purity is good and have high brightness and stable red luminescence using the compound excellent also in thermal stability.

[0016] In the organic electroluminescence devices containing the compound which has a quantum yield high originally, other purposes of this invention

promote the hole in a luminous layer, and electronic recombination, and are to offer the organic electroluminescence devices which present further high brightness and efficient luminescence.

[0017]

[Means for Solving the Problem] this invention person used to reach [that the red light emitting device of high brightness and high-reliability can be offered, and] a header and this invention, if the organic electroluminescence devices which constituted the luminescence field especially from an ingredient which can deliver energy a specific amino styryl compound to this efficiently are produced as a result of inquiring wholeheartedly, in order to solve the above-mentioned technical problem.

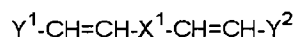
[0018] Namely, the organic layer in which this invention has a luminescence field is prepared between an anode plate and cathode, and sets the organic substance which emits light by impregnation of a current to the organic electroluminescence devices included as a component. At least one sort of the amino styryl compound by which at least one of the configuration layers of said organic layer is expressed with the following general formula [I] (although you may be one sort, you may be two sorts or more than it.) Organic electroluminescence devices characterized by consisting of an included mixture layer (the 1st organic EL device of this invention may be called hereafter) It

starts.

[0019]

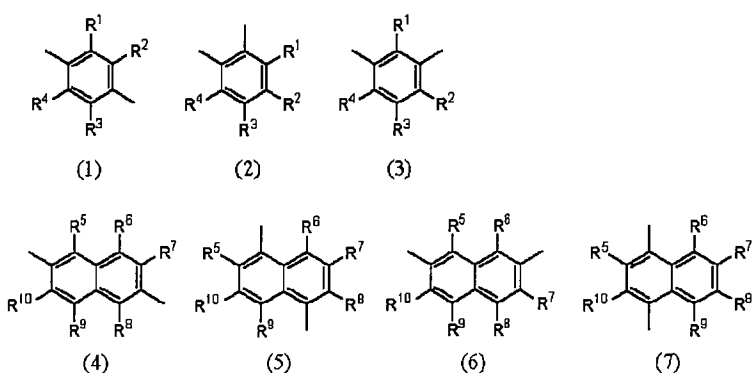
[Formula 25]

一般式 [I] :



It is the radical as which X1 is expressed in either of following general formula (1)

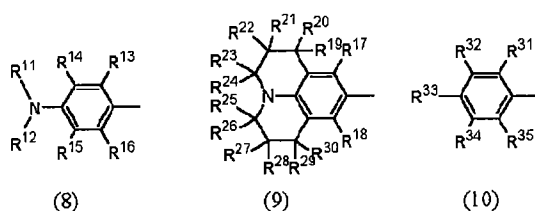
- (7) in [I], however said general formula [I], and is [Formula 26].



At least one among [However, said general formula (1) setting to - (3).] R1-R4 (one or two [for example,]) a halogen atom (a fluorine atom --) They are a nitro group, a cyano group, and a fluoro alkyl group (trifluoromethyl radical etc.: hereafter) similarly below :, such as a chlorine atom and a bromine atom. It is the radical chosen from it being the same. Others A hydrogen atom, an alkyl group, an aryl group, Are the radical chosen from an alkoxy group, the halogen atom, the nitro group, the cyano group, and the fluoro alkyl group, even if they are the same, may differ, and it sets to said general formula (4) - (7). At least one of

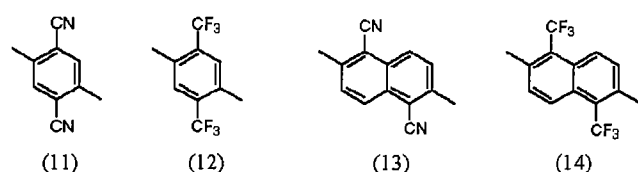
R5-R10 (one or two [for example,]) A halogen atom, it is the radical chosen from the nitro group, the cyano group, and the fluoro alkyl group, and others are the radicals chosen from a hydrogen atom, an alkyl group, an aryl group, an alkoxy group, the halogen atom, the nitro group, the cyano group, and the fluoro alkyl group, and even if they are the same, you may differ. Moreover, Y1 is a radical expressed with the following general formula (8) or (9), and Y2 is a radical expressed with the following general formula (8), (9), or (10).

[Formula 27]



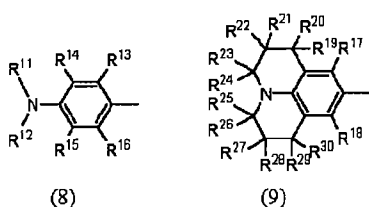
however, said general formula (8) - (10) -- setting -- R11 and R12 -- a hydrogen atom -- It is the radical chosen from the aryl group which may have the alkyl group which may have a substituent, and a substituent. You may differ, even if they are the same. R13-R35 A hydrogen atom, it is the radical chosen from the alkyl group which may have a substituent, the aryl group which may have a substituent, the alkoxy group which may have a substituent, the halogen atom, the nitro group, the cyano group, and the fluoro alkyl group, and even if they are the same, you may differ.]

[0020] It is the radical as which X1 is expressed in either of following structure-expression (11) - (14) in said general formula [I], and is [Formula 28].



Moreover, Y1 and Y2 may be radicals expressed with the following general formula (8) or (9) (following, the same).

[Formula 29]



(However, in said general formula (8) and (9), although R11 and R12 are the same as the above mentioned thing and R13-R30 are the same as the above mentioned thing, in the case of a fluoro alkyl group, it is a trifluoromethyl radical.)

[0021] In the 1st organic EL device of this invention, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and may consist of said mixture layer containing at least one sort of the amino styryl compound of said organic laminated structures to which said electron transport layer is expressed

with said general formula [I] at least.

[0022] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and may consist of said mixture layer containing at least one sort of the amino styryl compound of said organic laminated structures to which said hole transportation layer is expressed with said general formula [I] at least.

[0023] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and said hole transportation layer may consist of said mixture layer containing at least one sort of an amino styryl compound expressed with said general formula [I], and said electron transport layer may consist of said mixture layer containing at least one sort of an amino styryl compound expressed with said general formula [I].

[0024] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and you may consist of said mixture layer containing at least one sort of the amino styryl compound of said organic laminated structures to which said luminous layer is expressed with said general formula [I] at least.

[0025] Although the mixture layer containing said amino styryl compound is formed in this invention, as an usable ingredient Besides said amino styryl compound, a hole transportation ingredient (for example, aromatic amine etc.), electronic transportation ingredients (for example, Alq3 and pyrazolines etc.) or a series of compounds (DCM and its analogue --) which are generally used as a dopant for red luminescence Porphyrins, phthalocyanines, a perylene compound, the Nile red, a squarylium compound, etc. are mentioned (following, the same).

[0026] In this case, when at least one sort of the above-mentioned amino styryl compound is mixed with other compounds in a mixture layer, it contains at 0.1 - 95% of a rate by the weight ratio, and the content as a dopant can be decided within the limits of this (following, the same).

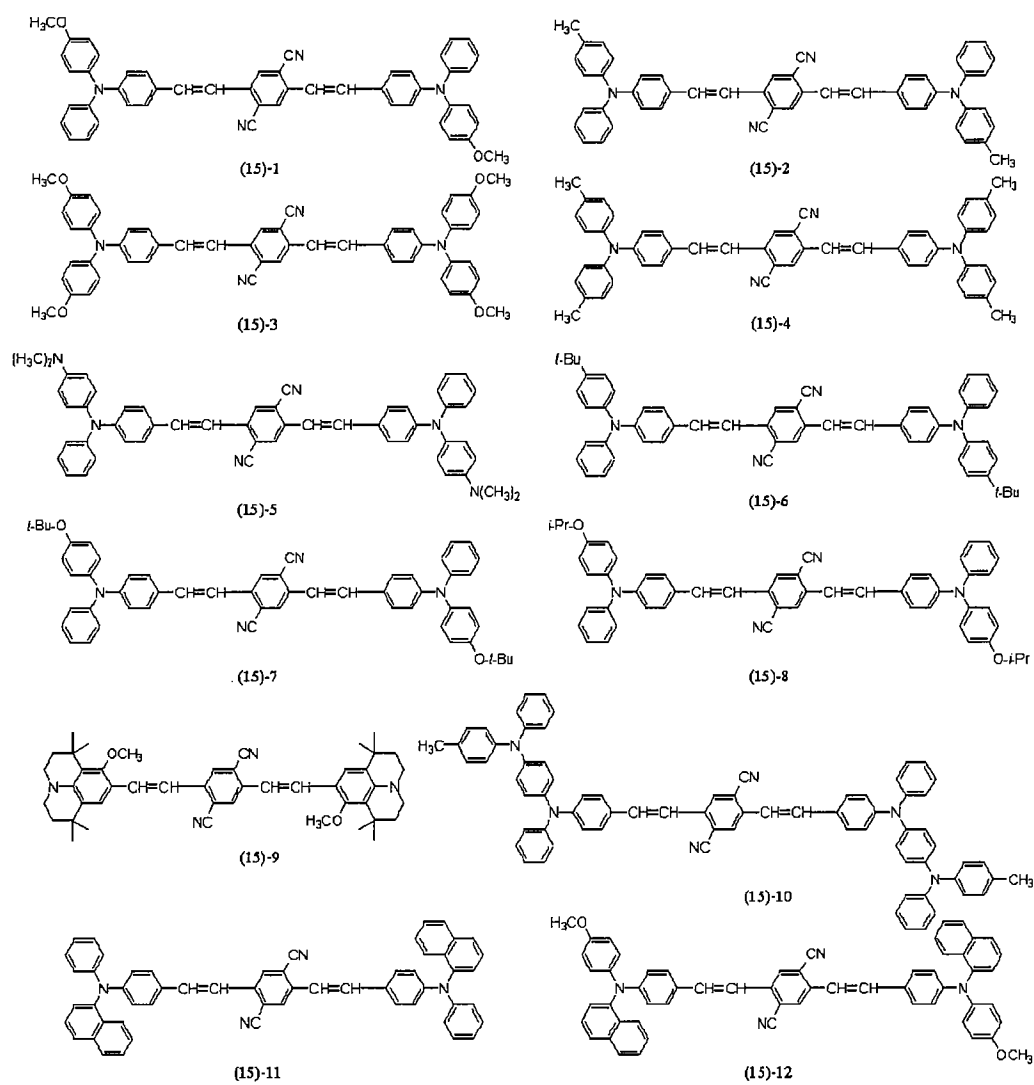
[0027] In addition, although a "mixture layer" means the mixture layer of the above-mentioned amino styryl compound and other compounds typically, the mixture layer of two sorts included by the above-mentioned amino styryl compound besides this or the amino styryl compound beyond it may also be meant here. Red luminescence of desired brightness or a chromaticity can be made to produce in the combination of two or more compounds by considering as such a mixture layer.

[0028] The organic electroluminescence devices of this invention are used for the luminescence equipment constituted as a display device, and are suitable

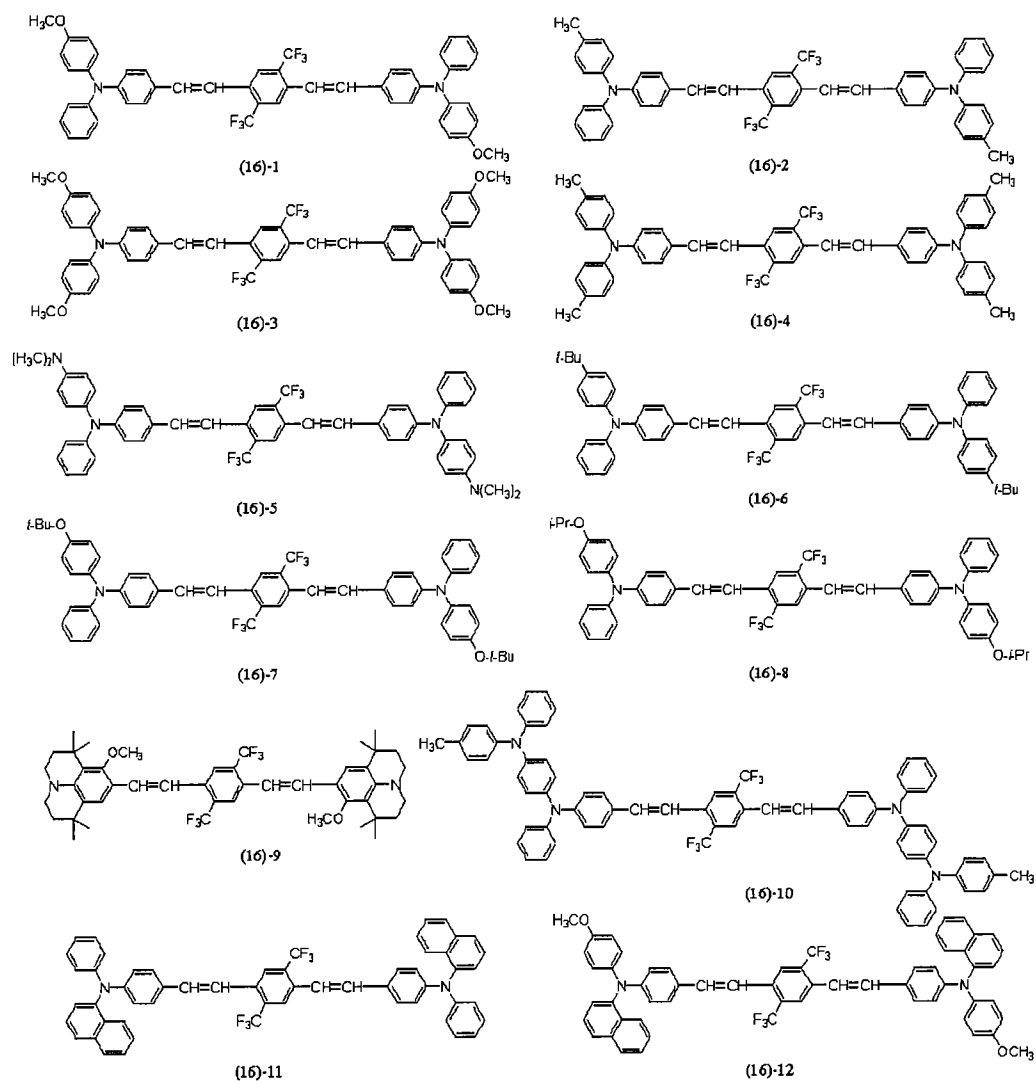
(following, the same).

[0029] In the organic electroluminescence devices by which the organic layer in which this invention has a luminescence field again is prepared between an anode plate and cathode At least one sort of the amino styryl compound by which at least one of the configuration layers of said organic layer is expressed with following structure-expression (15)-1-(15)-12, (16)-1-(16)-12, (17)-1-(17)-6, and (18)-1-(18)-6 (although you may be one sort) you may be two sorts or more than it. Organic electroluminescence devices characterized by consisting of an included mixture layer (the 2nd organic EL device of this invention may be called hereafter) It provides.

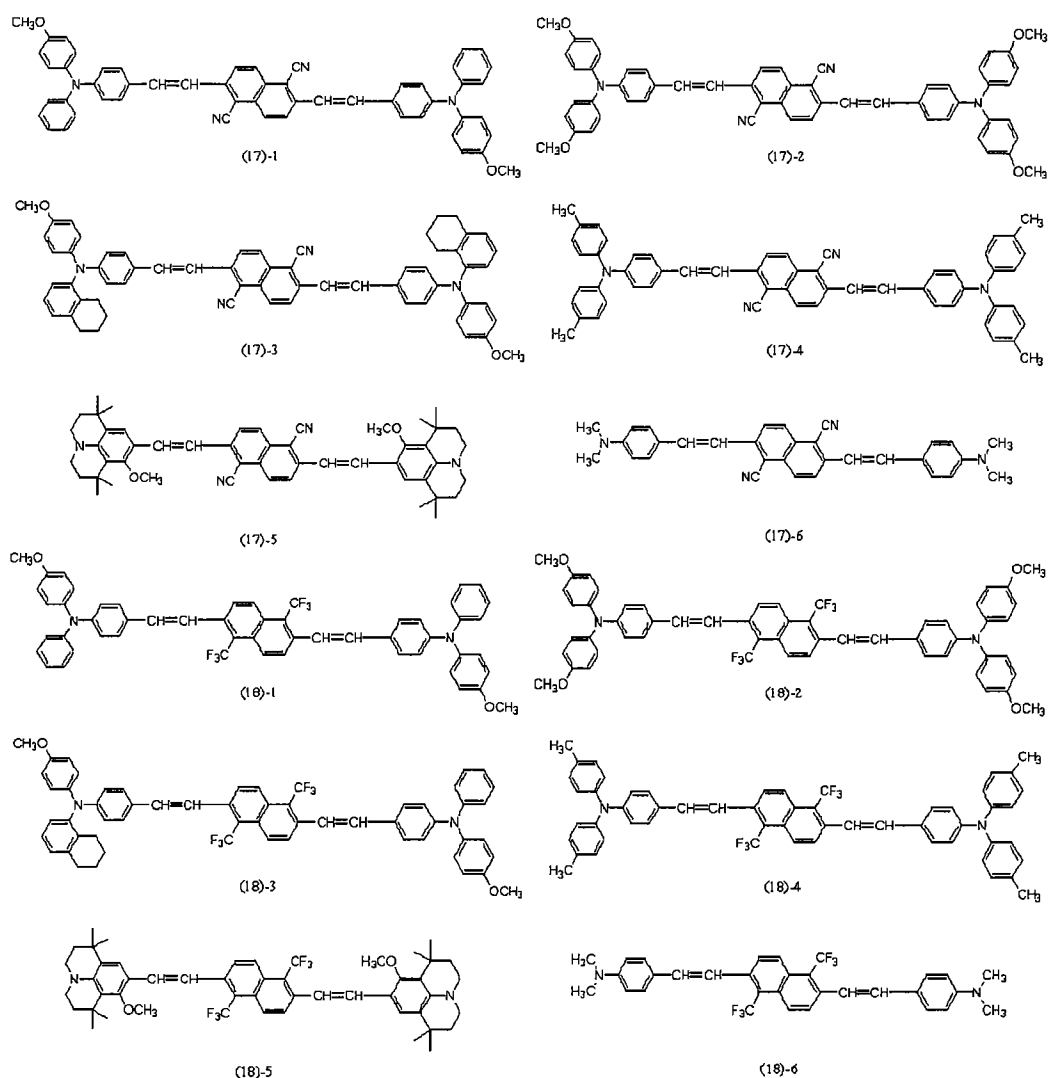
[Formula 30]



[Formula 31]



[Formula 32]



[0030] In the 2nd organic EL device of this invention, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and you may consist of said mixture layer of said organic laminated structures with which the electron transport layer contained at least one sort of said amino styryl compound at least.

[0031] Moreover, said organic layer is making the organic laminated structure to

which the laminating of a hole transportation layer and the electron transport layer was carried out, and you may consist of said mixture layer of said organic laminated structures with which the hole transportation layer contained at least one sort of said amino styryl compound at least.

[0032] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and said hole transportation layer may consist of said mixture layer containing at least one sort of said amino styryl compound, and said electron transport layer may consist of said mixture layer containing at least one sort of said amino styryl compound.

[0033] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and may consist of said mixture layer of said organic laminated structures with which the luminous layer contained at least one sort of said amino styryl compound at least.

[0034] Moreover, said at least one of the configuration layers of said organic layer may consist of said mixture layer containing at least one sort of said amino styryl compound, and the red luminescence coloring matter which has the luminescence maximum in the range of 600nm or more, for example, 600-700nm, (following, the same).

[0035] In this case, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and said at least one of the configuration layers of said organic layer may be said electron transport layer at least.

[0036] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and said at least one of the configuration layers of said organic layer may be said hole transportation layer at least.

[0037] Said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out. Said hole transportation layer Moreover, at least one sort of said amino styryl compound, said mixture layer containing the red luminescence coloring matter with which it consists of said mixture layer containing the red luminescence coloring matter which has the luminescence maximum in the range of 600nm or more, and said electron transport layer has the luminescence maximum in at least one sort of said amino styryl compound, and the range of 600nm or more -- since -- you may be.

[0038] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and you may consist of said mixture

layer containing the red luminescence coloring matter of said organic laminated structures said whose luminous layer has the luminescence maximum at least in at least one sort of said amino styryl compound, and the range of 600nm or more.

[0039] In the organic electroluminescence devices by which the organic layer in which this invention has a luminescence field again is prepared between an anode plate and cathode At least one sort of the amino styryl compound by which at least one of the configuration layers of said organic layer is expressed with said general formula [I] (although you may be one sort, you may be two sorts or more than it.) Organic electroluminescence devices characterized by consisting of an included luminescent mixture layer, and a hole (touching especially) blocking layer existing in the cathode side of said luminescent mixture layer (the 3rd organic EL device of this invention may be called hereafter) It provides.

[0040] In the 3rd organic EL device of this invention, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and may consist of said luminescent mixture layer containing at least one sort of the amino styryl compound of said organic laminated structures to which said electron transport layer is expressed with said general formula [I] at least.

[0041] Moreover, said organic layer is making the organic laminated structure to

which the laminating of a hole transportation layer and the electron transport layer was carried out, and may consist of said luminescent mixture layer containing at least one sort of the amino styryl compound of said organic laminated structures to which said hole transportation layer is expressed with said general formula [I] at least.

[0042] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out. Said hole transportation layer consists of said luminescent mixture layer containing at least one sort of an amino styryl compound expressed with said general formula [I]. Said electron transport layer may consist of said luminescent mixture layer containing at least one sort of an amino styryl compound expressed with said general formula [I], and said hole blocking layer may exist in the cathode side of the luminescent mixture layer of the electronic transportability of a parenthesis.

[0043] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and you may consist of said luminescent mixture layer containing at least one sort of the amino styryl compound of said organic laminated structures to which said luminous layer is expressed with said general formula [I] at least.

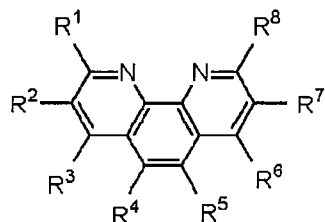
[0044] In the 3rd organic EL device of this invention, it is desirable for the ingredient which said hole blocking layer promoted the hole in a luminous layer and electronic recombination, can obtain further high brightness and efficient luminescence, and fitted such a hole blocking layer to be what has the following energy states (following, the same). Namely, the thing in energy level with the highest occupancy molecular-orbital level of the ingredient which forms a hole blocking layer lower than the highest occupancy molecular-orbital level of the ingredient which forms the layer which touches the anode plate side of a hole blocking layer, In addition, and the minimum non-occupying molecular-orbital level of the ingredient which forms a hole blocking layer It is being in energy level lower than the minimum non-occupying molecular-orbital level of the ingredient which forms the layer which is in energy level higher than the minimum non-occupying molecular-orbital level of the ingredient which forms the layer which touches the anode plate side of a hole blocking layer, and touches the cathode side of a hole blocking layer.

[0045] Although the phenanthroline derivative shown in each official report of JP,10-79297,A, JP,11-204258,A, JP,11-204264,A, and JP,11-204259,A etc. is mentioned as such an ingredient, if the conditions of the above-mentioned energy level are fulfilled, it will not be limited to a phenanthroline derivative. An usable phenanthroline derivative is shown below.

[0046]

[Formula 33]

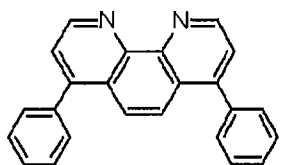
フェナントロリン誘導体の一般式：



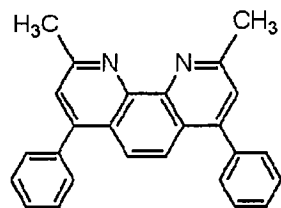
(R1-R8 express a hydrogen atom, a permutation or an unsubstituted alkyl group, a permutation or an unsubstituted aryl group, a permutation or the unsubstituted amino group, a halogen atom, a nitro group, a cyano group, or a hydroxyl group among this general formula.)

[Formula 34]

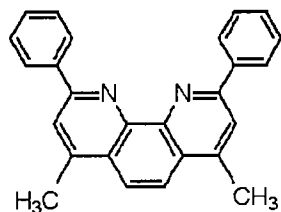
構造式 1 :



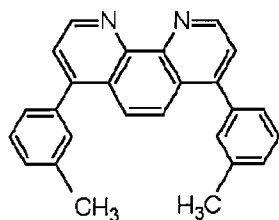
構造式 2 :



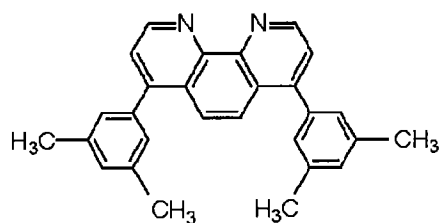
構造式 3 :



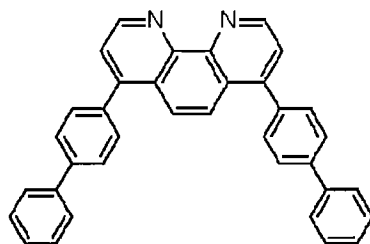
構造式 4 :



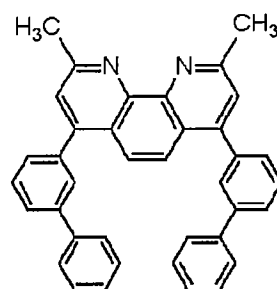
構造式 5 :



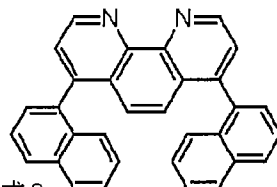
構造式 6 :



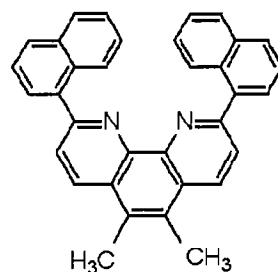
構造式 7 :



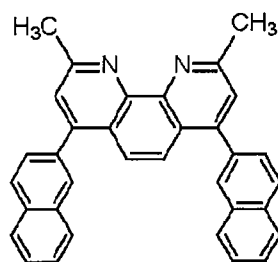
構造式 8 :



構造式 9 :



構造式 10 :



[0047] In the organic electroluminescence devices by which the organic layer in which this invention has a luminescence field again is prepared between an

anode plate and cathode At least one sort of the amino styryl compound by which at least one of the configuration layers of said organic layer is expressed with said structure-expression (15)-1-(15)-12, (16)-1-(16)-12, (17)-1-(17)-6, and (18)-1-(18)-6 (although you may be one sort) you may be two sorts or more than it. The organic electroluminescence devices (the 4th organic EL device of this invention may be called hereafter) characterized by consisting of an included luminescent mixture layer, and a hole blocking layer existing in the cathode side of said luminescent mixture layer are offered.

[0048] In the 4th organic EL device of this invention, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and you may consist of said luminescent mixture layer of said organic laminated structures with which the electron transport layer contained at least one sort of said amino styryl compound at least.

[0049] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and you may consist of said luminescent mixture layer of said organic laminated structures with which the hole transportation layer contained at least one sort of said amino styryl compound at least.

[0050] Moreover, said organic layer is making the organic laminated structure to

which the laminating of a hole transportation layer and the electron transport layer was carried out. Said hole transportation layer consists of said luminescent mixture layer containing at least one sort of said amino styryl compound. Said electron transport layer may consist of said luminescent mixture layer containing at least one sort of said amino styryl compound, and said hole blocking layer may exist in the cathode side of the luminescent mixture layer of the electronic transportability of a parenthesis.

[0051] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and may consist of said luminescent mixture layer of said organic laminated structures with which the luminous layer contained at least one sort of said amino styryl compound at least.

[0052] Moreover, said at least one of the configuration layers of said organic layer may consist of said luminescent mixture layer containing at least one sort of said amino styryl compound, and the red luminescence coloring matter which has the luminescence maximum in the range of 600nm or more.

[0053] In this case, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and said at least one of the configuration layers of said organic layer may be said electron transport layer at least.

[0054] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and said at least one of the configuration layers of said organic layer may be said hole transportation layer at least.

[0055] Said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out. Said hole transportation layer Moreover, at least one sort of said amino styryl compound, It consists of said luminescent mixture layer containing the red luminescence coloring matter which has the luminescence maximum in the range of 600nm or more. Said electron transport layer At least one sort of said amino styryl compound, It may consist of said luminescent mixture layer containing the red luminescence coloring matter which has the luminescence maximum in the range of 600nm or more, and said hole blocking layer may exist in the cathode side of the luminescent mixture layer of the electronic transportability of a parenthesis.

[0056] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and you may consist of said luminescent mixture layer containing the red luminescence coloring matter of said organic laminated structures said whose luminous layer has the

luminescence maximum at least in at least one sort of said amino styryl compound, and the range of 600nm or more.

[0057] In the organic electroluminescence devices by which the organic layer in which this invention has a luminescence field again is prepared between an anode plate and cathode At least one of the configuration layers of said organic layer consists of an amino styryl compound layer which consisted of amino styryl compound independent expressed with said general formula [I]. And organic electroluminescence devices characterized by a hole (touching especially) blocking layer existing in the cathode side of said amino styryl compound layer (the 5th organic EL device of this invention may be called hereafter) It provides.

[0058] In the 5th organic EL device of this invention, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and as for inside [it is said organic laminated structure], said electron transport layer may consist of said amino styryl compound layer at least.

[0059] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and as for inside [it is said organic laminated structure], said hole transportation layer may consist of said amino styryl compound layer at least.

[0060] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, said hole transportation layer may consist of said amino styryl compound layer, said electron transport layer may consist of said amino styryl compound layer, and said hole blocking layer may exist in the cathode side of the amino styryl compound layer of the electronic transportability of a parenthesis.

[0061] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and as for inside [it is said organic laminated structure], said luminous layer may consist of said amino styryl compound layer at least.

[0062] The hole blocking layer in the 5th organic EL device of this invention may be constituted like said hole blocking layer in the 3rd organic EL device of this invention.

[0063] In the organic electroluminescence devices by which the organic layer in which this invention has a luminescence field further is prepared between an anode plate and cathode At least one of the configuration layers of said organic layer Said structure-expression (15)-1- (15) It consists of an amino styryl compound layer which consisted of amino styryl compound independent

expressed with -12, (16)-1-(16)-12, (17)-1-(17)-6, and (18)-1-(18)-6. And organic electroluminescence devices characterized by a hole blocking layer existing in the cathode side of said amino styryl compound layer (the 6th organic EL device of this invention may be called hereafter) It provides.

[0064] In the 6th organic EL device of this invention, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and as for inside [it is said organic laminated structure], the electron transport layer may consist of said amino styryl compound layer at least.

[0065] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out, and as for inside [it is said organic laminated structure], the hole transportation layer may consist of said amino styryl compound layer at least.

[0066] Moreover, while said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer and the electron transport layer was carried out and said hole transportation layer consists of said amino styryl compound layer, said electron transport layer may consist of said amino styryl compound layer, and said hole blocking layer may exist in the cathode side of the amino styryl compound layer of the electronic transportability

of a parenthesis.

[0067] Moreover, said organic layer is making the organic laminated structure to which the laminating of a hole transportation layer, a luminous layer, and the electron transport layer was carried out, and as for inside [it is said organic laminated structure], the luminous layer may consist of said amino styryl compound layer at least.

[0068] The example of organic electroluminescence devices (organic EL device) based on this invention is shown in drawing 1 - drawing 9 , respectively.

[0069] Drawing 1 is the transparency mold organic electroluminescence devices A to which the luminescence light 20 penetrates cathode 3, and the luminescence light 20 can be observed also from a protective layer 4 side. Drawing 2 shows the reflective mold organic electroluminescence devices B which also obtain the reflected light in cathode 3 as a luminescence light 20.

[0070] One is a substrate for forming organic electroluminescence devices among drawing. Glass, plastics, and other proper ingredients can be used. Moreover, a substrate can also be shared when using organic electroluminescence devices combining other display devices. 2 is a transparent electrode and can use ITO (Indium tin oxide) and SnO₂ grade.

[0071] Moreover, 5 contains the amino styryl compound which is an organic luminous layer and was described above as a luminescent material (however at

least one sort mixing the above-mentioned amino styryl compound with other compounds, or using together two or more sorts of amino styryl compounds below content: the same). About this luminous layer, well-known various configurations can be conventionally used as lamination which obtains organic electroluminescence 20. When the ingredient which constitutes an electron hole (hole) transportation layer or an electron transport layer has a luminescence so that a postscript may be carried out for example, the structure which carried out the laminating of these thin films can be used. Furthermore, in order to raise charge transportability ability in the range which fills the purpose of this invention, both an electron hole transportation layer, and both [either or] bar using the structure which carried out the laminating of the thin film of two or more sorts of ingredients, or the thin film which consists of a presentation which mixed two or more sorts of ingredients. Moreover, in order to improve the luminescence engine performance, the ingredient of at least one or more sorts of fluorescence may be used, and the structure which pinched this thin film between the electron hole transportation layer and the electron transport layer, and the structure where the ingredient of at least one or more sorts of fluorescence was further included in an electron hole transportation layer, electron transport layers, or these both may be used. In order to improve luminous efficiency in these cases, it is also possible to include the thin film for controlling transportation of an

electron hole (hole) or an electron in the lamination.

[0072] Since the amino styryl compound which expressed with the above-mentioned general formula [I] has both electronic transportability ability and electron hole transportability ability, it can be used also as a mixed luminous layer with an electron hole transportability ingredient also as a mixed luminous layer with an electronic transportability ingredient among component structure. Moreover, it is also possible to use the mixolimnion containing this compound as a luminescent material with the configuration put between the electron transport layer and the electron hole transportation layer.

[0073] In addition, among drawing 1 and drawing 2 , three are cathode and can use the alloy or the structure which carried out the laminating of a metal [activity / calcium / Li, Mg,] and metals, such as Ag, aluminum, and In, as an electrode material. In the organic electroluminescence devices of a transparency mold, the light transmittance suitable for an application can be obtained by adjusting the thickness of cathode. Moreover, among drawing, four are the closure and a protective layer, and are making the organic whole electroluminescence devices into wrap structure, and the effectiveness goes up them. A proper ingredient can be used if airtightness is maintained.

[0074] In the organic electroluminescence devices based on this invention, the organic layer has the organic laminated structure (it is terrorism structure to a

single) to which the laminating of an electron hole transportation layer and the electron transport layer was carried out, and the mixture layer which contains said amino styryl compound as a formation ingredient of an electron hole transportation layer or an electron transport layer may be used. Or the organic layer has the organic laminated structure (double hetero structure) to which the laminating of an electron hole transportation layer, a luminous layer, and the electron transport layer was carried out one by one, and the mixture layer which contains said styryl compound as a formation ingredient of a luminous layer may be used.

[0075] When the example of the organic electroluminescence devices which have such an organic laminated structure is shown, drawing 3 has the laminated structure to which the laminating of organic layer 5a which consists of an anode plate 2, and the electron hole transportation layer 6 and electron transport layer 7 of translucency on the substrate 1 of translucency, and the cathode 3 was carried out one by one, and is the organic electroluminescence devices C of the single hetero structure where a protective layer 4 comes to carry out the closure of this laminated structure.

[0076] In the case of the lamination which omitted the luminous layer as shown in drawing 3 , the luminescence 20 of predetermined wavelength is generated from the interface of the electron hole transportation layer 6 and an electron

transport layer 7. These luminescence is observed from a substrate 1 side.

[0077] Moreover, drawing 4 has the laminated structure to which the laminating of organic layer 5b which consists of an anode plate 2, and the electron hole transportation layer 10, the luminous layer 11 and electron transport layer 12 of translucency on the substrate 1 of translucency, and the cathode 3 was carried out one by one, and is the organic electroluminescence devices D of the double hetero structure where a protective layer 4 comes to carry out the closure of this laminated structure.

[0078] In the organic electroluminescence devices shown in drawing 4 , the electron with which the electron hole poured in from the anode plate 2 was poured in from cathode 3 through the electron hole transportation layer 10 reaches a luminous layer 11 through an electron transport layer 12, respectively by impressing direct current voltage between an anode plate 2 and cathode 3. Consequently, the recombination of an electron/electron hole arises in a luminous layer 11, a singlet exciton generates, and luminescence of predetermined wavelength is generated from this singlet exciton.

[0079] each organic electroluminescence devices C and D mentioned above -- setting -- a substrate 1 -- for example, the ingredient of light transmission nature, such as glass and plastics, -- ***** -- things are made. Moreover, this substrate may be shared, when using combining other display devices, or when

arranging the laminated structure shown in drawing 3 and drawing 4 in the shape of a matrix. Moreover, Components C and D can all take any structure of a transparency mold and a reflective mold.

[0080] Moreover, an anode plate 2 is a transparent electrode and ITO and SnO₂ grade can be used for it. Between this anode plate 2 and the electron hole transportation layer 6 (or electron hole transportation layer 10), the thin film which consists of the organic substance or an organometallic compound may be prepared in order to improve charge injection efficiency. In addition, when the protective layer 4 is formed with conductive ingredients, such as a metal, the insulator layer may be prepared in the side face of an anode plate 2.

[0081] Moreover, the electron hole transportation layer 6 and an electron transport layer 7 are organic layers by which the laminating was carried out, the mixture containing the amino styryl compound described above to these either or both sides contains organic layer 5a in the organic electroluminescence devices C, and it is good as the luminescent electron hole transportation layer 6 or a luminescent electron transport layer 7. Organic layer 5b in the organic electroluminescence devices D can take various laminated structures, although the luminous layer 11 which consists of mixture containing the electron hole transportation layer 10 and the above-mentioned amino styryl compound, and an electron transport layer 12 are organic layers by which the laminating was

carried out. For example, both an electron hole transportation layer, and both [either or] may emit light.

[0082] Moreover, in an electron hole transportation layer, in order to raise electron hole transportability ability, the electron hole transportation layer which carried out the laminating of two or more sorts of electron hole transportation ingredients may be formed.

[0083] Moreover, in the organic electroluminescence devices C, although a luminous layer may be the electronic transportability luminous layer 7, depending on the electrical potential difference impressed from a power source 8, light may be emitted by the electron hole transportation layer 6 or its interface. Similarly, in the organic electroluminescence devices D, a luminous layer may be an electron transport layer 12 in addition to layer 11, and may be the electron hole transportation layer 10. In order to raise the luminescence engine performance, it is good that it is the structure made [the luminous layer 11 using at least one sort of fluorescence ingredients] to **** between an electron hole transportation layer and an electron transport layer. Or the structure where an electron hole transportation layer, an electron transport layer, or both [these] layers were made to contain this fluorescence ingredient may be constituted. In such a case, in order to improve luminous efficiency, it is also possible to include the thin films (a hole blocking layer, exciton generation layer, etc.) for controlling

transportation of an electron hole or an electron in the lamination.

[0084] Moreover, you may be the structure in which could use the alloy of a metal [activity / calcium / Li, Mg,] and metals, such as Ag, aluminum, and In, as an ingredient used for cathode 3, and these metal layers carried out the laminating. In addition, the organic electroluminescence devices corresponding to an application are producible by choosing the thickness and the quality of the material of cathode suitably.

[0085] Moreover, a protective layer 4 can improve charge injection efficiency and luminous efficiency by acting as closure film and making the organic whole electroluminescence devices into wrap structure. In addition, if the airtightness is maintained, a single metal or alloys, such as aluminum, gold, and chromium, etc. can choose the ingredient suitably.

[0086] Although the current impressed to each above-mentioned organic electroluminescence devices is usually a direct current, pulse current and an alternating current may be used. If a current value and an electrical-potential-difference value are within the limits which does not carry out component destruction, there will be especially no limit, but when the power consumption and the life of organic electroluminescence devices are taken into consideration, it is desirable to make light emit efficiently with as small electrical energy as possible.

[0087] drawing 5 - drawing 9 -- **** -- drawing 1 - drawing 4 -- having been shown -- an organic EL device -- A-D -- setting -- a luminous layer -- five -- an electron hole -- transportation -- a layer -- six -- an electron transport layer -- seven -- or -- a luminous layer -- 11 -- cathode -- three -- a side -- touching -- a hole -- blocking -- a layer -- 30 -- having prepared -- an example -- A -- ' - D -- ' -- respectively -- being shown . Here, as the above-mentioned amino styryl compound was mentioned above, also except that at least one sort is mixed with other compounds, two or more amino styryl compounds may be used together. Or the layer may be made by the single amino styryl compound independent.

[0088] Next, drawing 10 is the example of a configuration of the flat-surface display which used the organic electroluminescence devices of this invention. In the full color display, like illustration, red (R) and the green organic layer 5 (5a, 5b) which can emit light in the three primary colors of (G) and blue (B) are allotted between cathode 3 and an anode plate 2. It can prepare in the shape of [which crosses mutually] a stripe, it is chosen by the luminance-signal circuit 14 and the control circuit 15 with a built-in shift register, and a signal level is impressed to each, and cathode 3 and an anode plate 2 are constituted so that the organic layer of the location (pixel) where the cathode 3 and the anode plate 2 which were chosen by this cross may emit light.

[0089] That is, it is a 8x3RGB simple matrix, and drawing 10 arranges the

layered product 5 which consists of one between cathode 3 and an anode plate 2, even if there are few electron hole transportation layers, and luminous layers and electron transport layers either (refer to drawing 3 or drawing 4). Both cathode and an anode plate are made to intersect perpendicularly in the shape of a matrix mutually, impress a signal level serially by a control circuit 15 and the luminance-signal circuit 14 with a built-in shift register, and they are constituted so that light may be emitted in the decussation location, while carrying out patterning to the shape of a stripe. Of course, the EL element of this configuration can be used also as picture reproducer as a display of an alphabetic character, a notation, etc. Moreover, the stripe-like pattern of cathode 3 and an anode plate 2 is arranged for every color of red (R), green (G), and blue (B), and it becomes possible to constitute multicolor or all full color solid-state mold flat-panel displays.

[0090]

[Example] Next, although the example of this invention is shown, this invention is not limited to this.

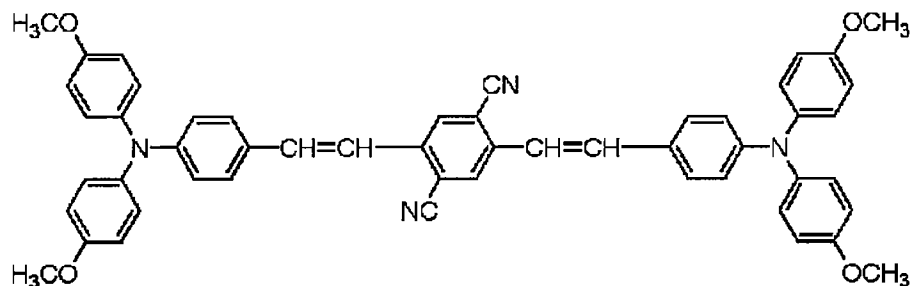
[0091] Example 1 this example is an example which produced the organic electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (15)-3, and

alpha-NPD (alpha-naphthylphenyl diamine) as an electron hole transportability
luminous layer.

[0092]

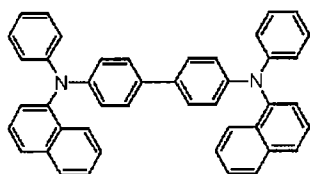
[Formula 35]

構造式 (15) - 3 :



[Formula 36]

α -NPD :



[0093] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the vacuum evaporation system was set. The substrate was approached, the metal mask which has two or more 2.0mmx2.0mm unit openings as a vacuum evaporation mask has been arranged, and the layer which mixed alpha-NPD which is the amino styryl compound and electron hole transportation ingredient

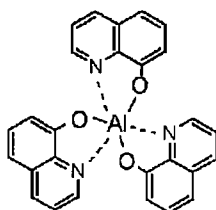
of above-mentioned structure-expression (15)-3 under the vacuum of 10^{-4} or less Pa by the weight ratio 1:1 with vacuum evaporation technique was formed as an electron hole transportation layer (*****) in thickness of 50nm. The vacuum evaporation rate was made respectively in 0.1nm/second.

[0094] Furthermore, Alq3 (tris (eight quinolinol) aluminum) of the following structure expression was vapor-deposited in contact with the electron hole transportation layer as an electron transport layer ingredient. Thickness of this electron transport layer that consists of Alq3 was also set to 50nm, and the vacuum evaporation rate was carried out in 0.2nm/second.

[0095]

[Formula 37]

Alq₃:



[0096] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg film) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 3 by the example 1.

[0097] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 1 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry, it obtained the spectrum which has a luminescence peak near 630nm. The spectroscope which used the photodiode array by the Otsuka electronic company as the detector was used for spectrometry. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 2000 cd/m² was obtained by 8V.

[0098] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 900 hours until brightness was halved.

[0099] Example 2 this example is an example which produced the organic electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-3, and Alq₃ as an electronic transportability luminous layer.

[0100] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the vacuum evaporation system was set. The substrate was approached, the metal mask which has two or more 2.0mmx2.0mm unit openings as a vacuum evaporation mask has been arranged, and alpha-NPD of said structure expression was formed in thickness of 50nm under the vacuum of 10^{-4} or less Pa with the vacuum deposition method. The vacuum evaporation rate was carried out in 0.1nm/second.

[0101] Furthermore, the layer which mixed Alq3 which is the amino styryl compound and electronic transportability ingredient of above-mentioned structure-expression (15)-3 by the weight ratio 1:1 was vapor-deposited in contact with the electron hole transportation layer. The above-mentioned structure expression (15) Thickness of the electron transport layer (*****) which consists of an amino styryl compound of -3 and Alq3 was also set to 50nm, and the vacuum evaporation rate was made respectively in 0.2nm/second.

[0102] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 3 .

[0103] Thus, forward bias direct current voltage was applied to the organic

electroluminescence devices of the produced example 2 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 630nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1200 cd/m² was obtained by 8V.

[0104] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 800 hours until brightness was halved.

[0105] Example 3 this example is an example which produced the organic electroluminescence devices of double hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-3, and Alq₃ as an electronic transportability luminous layer.

[0106] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the vacuum evaporation system was set. The substrate was approached, the metal

mask which has two or more 2.0mmx2.0mm unit openings as a vacuum evaporation mask has been arranged, and alpha-NPD of the above-mentioned structure expression was formed in thickness of 30nm under the vacuum of 10^{-4} or less Pa with the vacuum deposition method. The vacuum evaporation rate was carried out in 0.2nm/second.

[0107] Furthermore, the amino styryl compound of above-mentioned structure-expression (15)-3 and Alq3 were vapor-deposited in contact with the electron hole transportation layer by the weight ratio 1:1 as a luminescent material. The above-mentioned structure expression (15) Thickness of the luminous layer which consists of a mixture layer of the amino styryl compound of -3 and Alq3 was also set to 30nm, and the vacuum evaporation rate was made respectively in 0.2nm/second.

[0108] Furthermore, Alq3 of the above-mentioned structure expression was vapor-deposited in contact with the luminous layer as an electronic transportability ingredient. Thickness of Alq3 was set to 30nm, and the vacuum evaporation rate was carried out in 0.2nm/second.

[0109] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 4 by

the example 3.

[0110] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 3 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak in 630nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 2500 cd/m² was obtained by 8V.

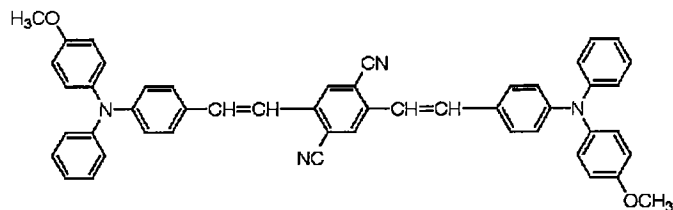
[0111] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 1500 hours until brightness was halved.

[0112] Example 4 this example is an example which produced the organic electroluminescence devices of double hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-3, and the amino styryl compound of following structure-expression (15)-1 as a luminous layer.

[0113]

[Formula 38]

構造式 (15) -1 :



[0114] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the vacuum evaporation system was set. The substrate was approached, the metal mask which has two or more 2.0mmx2.0mm unit openings as a vacuum evaporation mask has been arranged, and alpha-NPD of the above-mentioned structure expression was formed in thickness of 30nm under the vacuum of 10^{-4} or less Pa with the vacuum deposition method. The vacuum evaporation rate was carried out in 0.2nm/second.

[0115] Furthermore, in contact with the electron hole transportation layer, vapor codeposition of the amino styryl compound of above-mentioned structure-expression (15)-3 and the amino styryl compound of above-mentioned structure-expression (15)-1 was carried out by the weight ratio 1:3 as a luminescent material. The above-mentioned structure expression (15) Also setting to 30nm thickness of the luminous layer which consists of a mixture layer

of the amino styryl compound of -3, and the amino styryl compound of above-mentioned structure-expression (15)-1, in the vacuum evaporation rate, the compound of above-mentioned structure-expression (15)-3 carried out the compound of 0.1nm /and above-mentioned structure-expression (15)-1 in 0.3nm/second a second.

[0116] Furthermore, Alq3 of the above-mentioned structure expression was vapor-deposited in contact with the luminous layer as an electronic transportability ingredient. Thickness of Alq3 was set to 30nm, and the vacuum evaporation rate was carried out in 0.2nm/second.

[0117] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 4 by the example 3.

[0118] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 4 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak in 640nm. When the electrical-potential-difference-measurement of luminance was

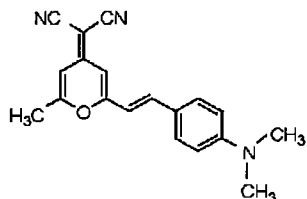
performed, the brightness of 3000 cd/m² was obtained by 8V.

[0119] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 1200 hours until brightness was halved.

[0120] Example 5 this example is an example which produced the organic electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-3, and DCM of the following structure expression as an electronic transportability luminous layer.

[Formula 39]

DCM:



[0121] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the

vacuum evaporation system was set. The substrate was approached, the metal mask which has two or more 2.0mmx2.0mm unit openings as a vacuum evaporation mask has been arranged, and alpha-NPD of the above-mentioned structure expression was formed in thickness of 50nm under the vacuum of 10^{-4} or less Pa with the vacuum deposition method. The vacuum evaporation rate was carried out in 0.1nm/second.

[0122] Furthermore, the layer which mixed Above DCM with the amino styryl compound of above-mentioned structure-expression (15)-3 by the weight ratio 10:1 was vapor-deposited in contact with the electron hole transportation layer. The above-mentioned structure expression (15) Also setting to 50nm thickness of the electron transport layer (*****) which consists of an amino styryl compound of -3, and the above DCM, the compound of above-mentioned structure-expression (15)-3 was carried out in 0.5nm /, and the vacuum evaporation rate carried out DCM in 0.05nm/second a second.

[0123] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 3 .

[0124] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 5 under

nitrogen-gas-atmosphere environment, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 630nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 800 cd/m² was obtained by 8V.

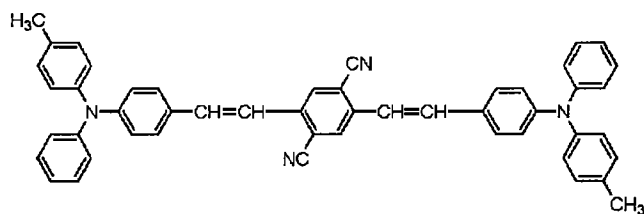
[0125] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere environment, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 500 hours until brightness was halved.

[0126] Example 6 this example is an example which produced the organic electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (15)-2, and Alq₃ as an electronic transportability luminous layer.

[0127]

[Formula 40]

構造式 (15) - 2 :



[0128] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0129] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 6 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was orange, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 590nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 850 cd/m² was obtained by 8V.

[0130] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 600 hours until brightness was halved.

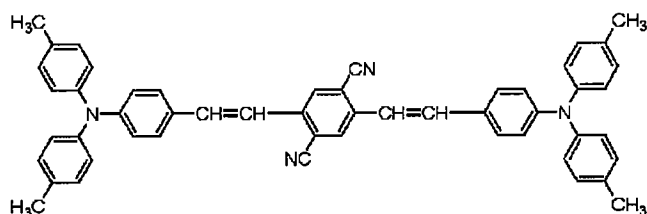
[0131] Example 7 this example is an example which produced the organic

electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (15)-4, and Alq3 as an electronic transportability luminous layer.

[0132]

[Formula 41]

構造式 (15) - 4 :



[0133] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0134] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 7 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 610nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 800 cd/m² was obtained by 8V.

[0135] After producing these organic electroluminescence devices, although it

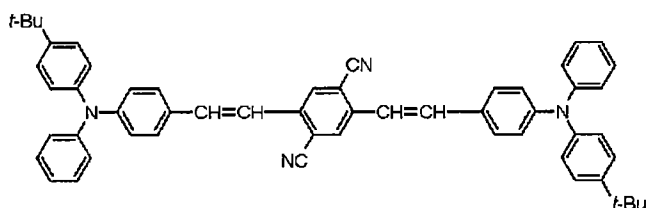
was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuous luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 450 hours until brightness was halved.

[0136] Example 8 this example is an example which produced the organic electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (15)-6, and Alq₃ as an electronic transportability luminous layer.

[0137]

[Formula 42]

構造式 (15) - 6 :



[0138] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0139] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 8 under

nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was orange, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 585nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 500 cd/m² was obtained by 8V.

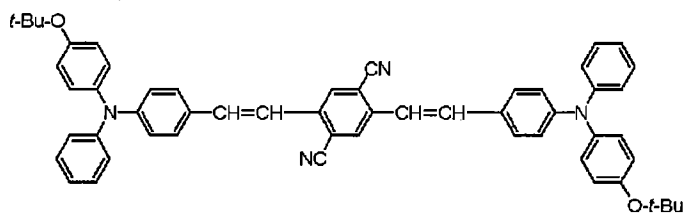
[0140] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 200 hours until brightness was halved.

[0141] Example 9 this example is an example which produced the organic electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (15)-7, and Alq₃ as an electronic transportability luminous layer.

[0142]

[Formula 43]

構造式 (15) - 7 :



[0143] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0144] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 9 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 615nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 580 cd/m² was obtained by 8V.

[0145] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 300 hours until brightness was halved.

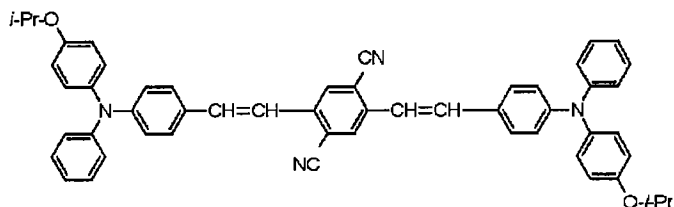
[0146] Example 10 this example is an example which produced the organic

electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (15)-8, and Alq3 as an electronic transportability luminous layer.

[0147]

[Formula 44]

構造式 (15) - 8 :



[0148] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0149] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 10 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 610nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 430 cd/m² was obtained by 8V.

[0150] After producing these organic electroluminescence devices, although it

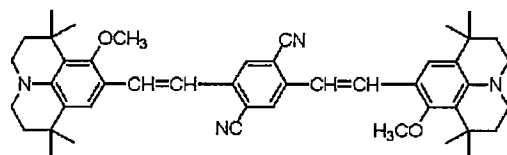
was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 150 hours until brightness was halved.

[0151] Example 11 this example is an example which produced the organic electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (15)-9, and Alq₃ as an electronic transportability luminous layer.

[0152]

[Formula 45]

構造式 (15) - 9 :



[0153] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0154] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 11 under

nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 640nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 800 cd/m² was obtained by 8V.

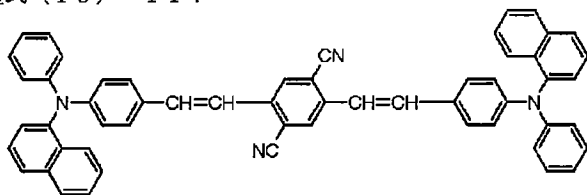
[0155] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 450 hours until brightness was halved.

[0156] Example 12 this example is an example which produced the organic electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (15)-11, and Alq₃ as an electronic transportability luminous layer.

[0157]

[Formula 46]

構造式 (15) - 11 :

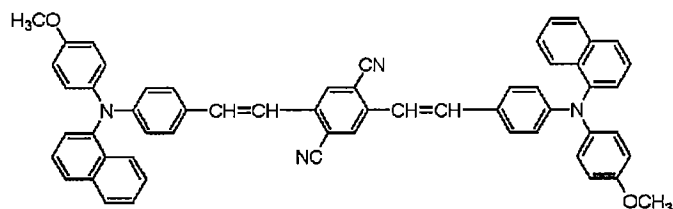


electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (15)-12, and Alq3 as an electronic transportability luminous layer.

[0162]

[Formula 47]

構造式 (15) - 12 :



[0163] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0164] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 13 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was orange, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 600nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 850 cd/m² was obtained by 8V.

[0165] After producing these organic electroluminescence devices, although it

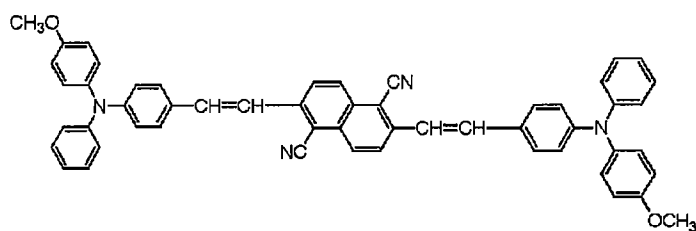
was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuous luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 600 hours until brightness was halved.

[0166] Example 14 this example is an example which produced the organic electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (17)-1, and Alq3 as an electronic transportability luminous layer.

[0167]

[Formula 48]

構造式 (17) - 1 :



[0168] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0169] Thus, forward bias direct current voltage was applied to the organic

electroluminescence devices of the produced example 14 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 620nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1500 cd/m² was obtained by 8V.

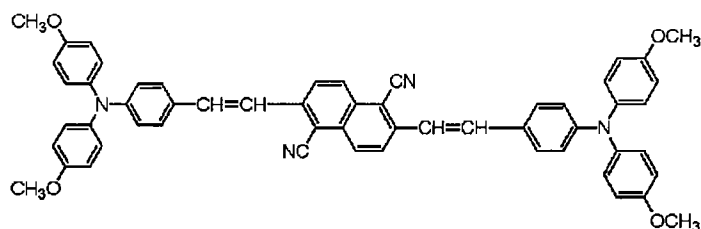
[0170] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 800 hours until brightness was halved.

[0171] Example 15 this example is an example which produced the organic electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (17)-2, and Alq₃ as an electronic transportability luminous layer.

[0172]

[Formula 49]

構造式 (17) - 2 :



[0173] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0174] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 15 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 645nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1200 cd/m² was obtained by 8V.

[0175] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 700 hours until brightness was halved.

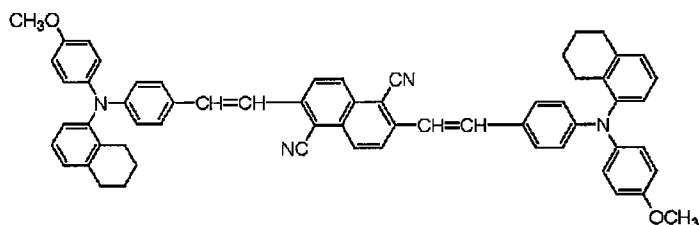
[0176] Example 16 this example is an example which produced the organic

electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (17)-3, and Alq3 as an electronic transportability luminous layer.

[0177]

[Formula 50]

構造式 (17) - 3 :



[0178] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0179] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 16 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 590nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 780 cd/m² was obtained by 8V.

[0180] After producing these organic electroluminescence devices, although it

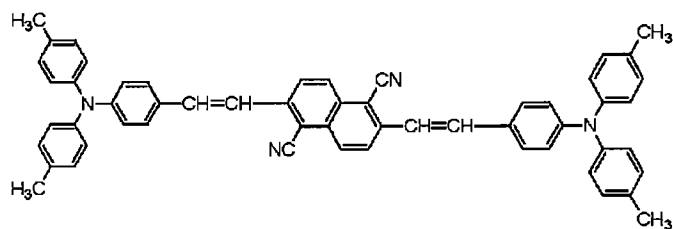
was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuous luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 500 hours until brightness was halved.

[0181] Example 17 this example is an example which produced the organic electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (17)-4, and Alq₃ as an electronic transportability luminous layer.

[0182]

[Formula 51]

構造式 (17) - 4 :



[0183] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0184] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 17 under

nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 620nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1100 cd/m² was obtained by 8V.

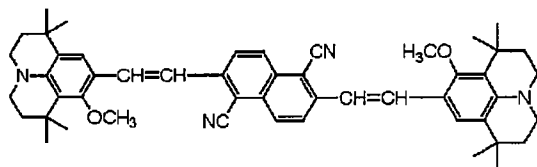
[0185] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 600 hours until brightness was halved.

[0186] Example 18 this example is an example which produced the organic electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (17)-5, and Alq₃ as an electronic transportability luminous layer.

[0187]

[Formula 52]

構造式 (17) - 5 :



[0188] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0189] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 18 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 650nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 700 cd/m² was obtained by 8V.

[0190] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 400 hours until brightness was halved.

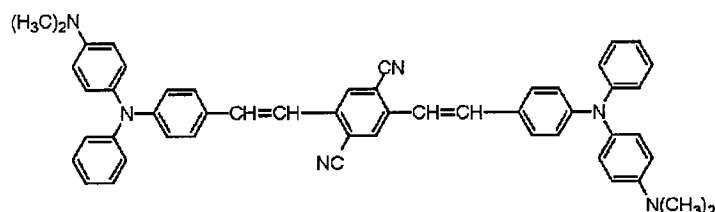
[0191] Example 19 this example is an example which produced the organic

electroluminescence devices of single hetero structure among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of following structure-expression (15)-5, and Alq3 as an electronic transportability luminous layer.

[0192]

[Formula 53]

構造式 (15) - 5 :



[0193] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 2.

[0194] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 19 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like an example 1, it obtained the spectrum which has a luminescence peak near 655nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1500 cd/m² was obtained by 8V.

[0195] After producing these organic electroluminescence devices, although it

was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 700 hours until brightness was halved.

[0196] Example 20 this example is an example which produced the organic electroluminescence devices of the single hetero structure which made the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-3, and Alq₃ the electronic transportability luminous layer further among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-3, and alpha-NPD as an electron hole transportability luminous layer.

[0197] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the vacuum evaporation system was set. The substrate was approached, the metal mask which has two or more 2.0mmx2.0mm unit openings as a vacuum evaporation mask has been arranged, and the layer which mixed alpha-NPD which is the amino styryl compound and electron hole transportation ingredient of above-mentioned structure-expression (15)-3 under the vacuum of 10^{-4} or

less Pa by the weight ratio 1:1 with vacuum evaporation technique was formed as an electron hole transportation layer (*****) in thickness of 50nm. The vacuum evaporation rate was made respectively in 0.1nm/second.

[0198] Furthermore, the layer which mixed Alq3 which is the compound and electronic transportability ingredient of above-mentioned structure-expression (15)-3 by the weight ratio 1:1 was vapor-deposited in contact with the electron hole transportation layer (*****). The above-mentioned structure expression (15) Thickness of the electron transport layer (*****) which consists of a compound of -3 and Alq3 was also set to 50nm, and the vacuum evaporation rate was made respectively in 0.2nm/second.

[0199] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg film) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 3 depended example 20.

[0200] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 20 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry, it obtained the spectrum which has a luminescence peak near 635nm. The

spectroscope which used the photodiode array by the Otsuka electronic company as the detector was used for spectrometry. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1800 cd/m² was obtained by 8V.

[0201] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 1000 hours until brightness was halved.

[0202] Example 21 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-3, and alpha-NPD (alpha-naphthylphenyl diamine) as an electron hole transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0203] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the vacuum evaporation system was set. The substrate was approached, the metal mask which has two or more 2.0mmx2.0mm unit openings as a vacuum

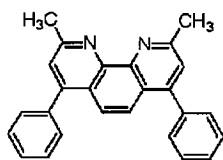
evaporation mask has been arranged, and the layer which mixed alpha-NPD which is the amino styryl compound and electron hole transportation ingredient of above-mentioned structure-expression (15)-3 under the vacuum of 10^{-4} or less Pa by the weight ratio 1:1 with vacuum evaporation technique was formed as an electron hole transportation layer (*****) in thickness of 50nm. The vacuum evaporation rate was made respectively in 0.1nm/second.

[0204] Furthermore, the bathocuproine of the following structure expression was vapor-deposited in contact with the electron hole transportation layer (*****) as a hole blocking layer ingredient. The thickness of this hole blocking layer that consists of bathocuproine set to 15nm, and the vacuum evaporation rate was carried out in 0.1nm/second.

[0205]

[Formula 54]

バソクプロイン：



[0206] Furthermore, Alq3 (tris (eight quinolinol) aluminum) of the above-mentioned structure expression was vapor-deposited in contact with the hole blocking layer as an electron transport layer ingredient. Thickness of this

electron transport layer that consists of Alq3 was also set to 50nm, and the vacuum evaporation rate was carried out in 0.2nm/second.

[0207] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg film) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 7 by the example 21.

[0208] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 21 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry, it obtained the spectrum which has a luminescence peak near 630nm. The spectroscopy which used the photodiode array by the Otsuka electronic company as the detector was used for spectrometry. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 2500 cd/m² was obtained by 8V.

[0209] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible

degradation by initial brightness 200 cd/m², it was 1000 hours until brightness was halved.

[0210] Example 22 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-3, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0211] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the vacuum evaporation system was set. The substrate was approached, the metal mask which has two or more 2.0mmx2.0mm unit openings as a vacuum evaporation mask has been arranged, and alpha-NPD of the following structure expression was formed in thickness of 30nm under the vacuum of 10⁻⁴ or less Pa with the vacuum deposition method. The vacuum evaporation rate was carried out in 0.1nm/second.

[0212] Furthermore, in contact with the electron hole transportation layer, vapor codeposition of the layer which mixed Alq₃ which is the compound and electronic transportability ingredient of above-mentioned structure-expression (15)-3 by the weight ratio 1:1 was carried out. The above-mentioned structure expression (15) Thickness of the electron transport layer (*****) which serves

as a compound of -3 from Alq3 was also set to 30nm, and the vacuum evaporation rate was made respectively in 0.2nm/second.

[0213] Furthermore, the bathocuproine of the above-mentioned structure expression was vapor-deposited in contact with the electron hole transportation layer (*****) as a hole blocking layer ingredient. The thickness of this hole blocking layer that consists of bathocuproine set to 15nm, and the vacuum evaporation rate was carried out in 0.1nm/second.

[0214] Furthermore, Alq3 of the above-mentioned structure expression was vapor-deposited in contact with the hole blocking layer as an electron transport layer ingredient. The thickness of this electron transport layer that consists of Alq3 set to 30nm, and the vacuum evaporation rate was carried out in 0.2nm/second.

[0215] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 9 .

[0216] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 22 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like

an example 21, it obtained the spectrum which has a luminescence peak near 630nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 3400 cd/m² was obtained by 8V.

[0217] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 1200 hours until brightness was halved.

[0218] Example 23 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-3, and the amino styryl compound of above-mentioned structure-expression (15)-1 as a luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0219] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the vacuum evaporation system was set. The substrate was approached, the metal mask which has two or more 2.0mmx2.0mm unit openings as a vacuum evaporation mask has been arranged, and alpha-NPD of the above-mentioned structure expression was formed in thickness of 30nm under the vacuum of 10 -

4 or less Pa with the vacuum deposition method. The vacuum evaporation rate was carried out in 0.2nm/second.

[0220] Furthermore, in contact with the electron hole transportation layer, vapor codeposition of the compound of above-mentioned structure-expression (15)-3 and the compound of above-mentioned structure-expression (15)-1 was carried out by the weight ratio 1:3 as a luminescent material. The above-mentioned structure expression (15) Also setting to 30nm thickness of the luminous layer which consists of a mixture layer of the compound of -3, and the compound of above-mentioned structure-expression (15)-1, in the vacuum evaporation rate, the compound of above-mentioned structure-expression (15)-3 carried out the compound of 0.1nm /and above-mentioned structure-expression (15)-1 in 0.3nm/second a second.

[0221] Furthermore, the bathocuproine of the above-mentioned structure expression was vapor-deposited in contact with the luminous layer as a hole blocking layer ingredient. The thickness of this hole blocking layer that consists of bathocuproine set to 15nm, and the vacuum evaporation rate was carried out in 0.1nm/second.

[0222] Furthermore, Alq3 of the above-mentioned structure expression was vapor-deposited in contact with the hole blocking layer as an electronic transportability ingredient. Thickness of Alq3 was set to 30nm, and the vacuum

evaporation rate was carried out in 0.2nm/second.

[0223] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 9 by the example 23.

[0224] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 23 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak in 640nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 4000 cd/m² was obtained by 8V.

 [0225] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 1600 hours until brightness was halved.

[0226] Example 24 this example is an example which produced the organic

electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-3, and DCM of the above-mentioned structure expression as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0227] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the vacuum evaporation system was set. The substrate was approached, the metal mask which has two or more 2.0mmx2.0mm unit openings as a vacuum evaporation mask has been arranged, and alpha-NPD of the above-mentioned structure expression was formed in thickness of 30nm under the vacuum of 10^{-4} or less Pa with the vacuum deposition method. The vacuum evaporation rate was carried out in 0.1nm/second.

[0228] Furthermore, in contact with the electron hole transportation layer, vapor codeposition of the layer which mixed Above DCM with the compound of above-mentioned structure-expression (15)-3 by the weight ratio 10:1 was carried out. The above-mentioned structure expression (15) Also setting to 30nm thickness of the electron transport layer (*****) which consists of a compound of -3, and the above DCM, the compound of above-mentioned structure-expression (15)-3 was carried out in 0.5nm /, and the vacuum

evaporation rate carried out DCM in 0.05nm/second a second.

[0229] Furthermore, the bathocuproine of the above-mentioned structure expression was vapor-deposited in contact with the luminous layer as a hole blocking layer ingredient. The thickness of this hole blocking layer that consists of bathocuproine set to 15nm, and the vacuum evaporation rate was carried out in 0.1nm/second.

[0230] Furthermore, Alq3 of the above-mentioned structure expression was vapor-deposited in contact with the hole blocking layer as an electronic transportability ingredient. Thickness of Alq3 was set to 30nm, and the vacuum evaporation rate was carried out in 0.2nm/second.

[0231] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 9 .

[0232] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 24 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 630nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 1000 cd/m² was obtained by 8V.

[0233] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 600 hours until brightness was halved.

[0234] Example 25 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-2, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0235] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0236] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 25 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was orange, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 590nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 1100 cd/m² was obtained by 8V.

[0237] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 700 hours until brightness was halved.

[0238] Example 26 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-4, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0239] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0240] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 26 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 610nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 1000 cd/m² was obtained by 8V.

[0241] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 550 hours until brightness was halved.

[0242] Example 27 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-6, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0243] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0244] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 27 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was orange, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 585nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 600 cd/m² was obtained by 8V.

[0245] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 300 hours until brightness was halved.

[0246] Example 28 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-7, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0247] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0248] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 28 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 615nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 650 cd/m² was obtained by 8V.

[0249] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 350 hours until brightness was halved.

[0250] Example 29 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-8, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0251] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0252] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 29 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 610nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 500 cd/m² was obtained by 8V.

[0253] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 200 hours until brightness was halved.

[0254] Example 30 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-9, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0255] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0256] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 30 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 640nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 920 cd/m² was obtained by 8V.

[0257] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 480 hours until brightness was halved.

[0258] Example 31 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the compound of above-mentioned structure-expression (15)-11, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0259] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0260] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 31 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was orange, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 580nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 1100 cd/m² was obtained by 8V.

[0261] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 800 hours until brightness was halved.

[0262] Example 32 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-12, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0263] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0264] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 32 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was orange, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 600nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 900 cd/m² was obtained by 8V.

[0265] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 660 hours until brightness was halved.

[0266] Example 33 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (17)-1, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0267] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0268] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 33 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 620nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 1650 cd/m² was obtained by 8V.

[0269] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 880 hours until brightness was halved.

[0270] Example 34 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (17)-2, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0271] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0272] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 34 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 645nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 1300 cd/m² was obtained by 8V.

[0273] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 800 hours until brightness was halved.

[0274] Example 35 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (17)-3, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0275] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0276] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 35 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 600nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 1450 cd/m² was obtained by 8V.

[0277] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 700 hours until brightness was halved.

[0278] Example 36 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (17)-4, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0279] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0280] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 36 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 620nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 1200 cd/m² was obtained by 8V.

[0281] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 650 hours until brightness was halved.

[0282] Example 37 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (17)-5, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0283] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0284] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 37 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 650nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 800 cd/m² was obtained by 8V.

[0285] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 500 hours until brightness was halved.

[0286] Example 38 this example is an example which produced the organic electroluminescence devices which used the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-5, and Alq₃ as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0287] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 22.

[0288] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 38 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 21, it obtained the spectrum which has a luminescence peak near 655nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 1720 cd/m² was obtained by 8V.

[0289] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 780 hours until brightness was halved.

[0290] Example 39 this example is an example which produced the organic electroluminescence devices which made the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-3, and Alq₃ the electronic transportability luminous layer further among the amino styryl compounds of an above-mentioned general formula [I], using the mixture layer of the amino styryl compound of above-mentioned structure-expression (15)-3, and alpha-NPD as an electron hole transportability luminous layer.

[0291] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the vacuum evaporation system was set. The substrate was approached, the metal mask which has two or more 2.0mmx2.0mm unit openings as a vacuum evaporation mask has been arranged, and the layer which mixed alpha-NPD which is the compound and electron hole transportation ingredient of

above-mentioned structure-expression (15)-3 under the vacuum of 10^{-4} or less Pa by the weight ratio 1:1 with the vacuum deposition method was formed as an electron hole transportation layer (*****), in thickness of 30nm. The vacuum evaporation rate was made respectively in 0.1nm/second.

[0292] Furthermore, in contact with the electron hole transportation layer (*****), vapor codeposition of the layer which mixed Alq3 which is the compound and electronic transportability ingredient of above-mentioned structure-expression (15)-3 by the weight ratio 1:1 was carried out. The above-mentioned structure expression (15) Thickness of the electron transport layer (*****) which consists of a compound of -3 and Alq3 was also set to 30nm, and the vacuum evaporation rate was made respectively in 0.2nm/second.

[0293] Furthermore, the bathocuproine of the above-mentioned structure expression was vapor-deposited in contact with the electron transport layer (*****) as a hole blocking layer ingredient. The thickness of this hole blocking layer that consists of bathocuproine set to 15nm, and the vacuum evaporation rate was carried out in 0.1nm/second.

[0294] Furthermore, Alq3 of the above-mentioned structure expression was vapor-deposited in contact with the hole blocking layer as an electronic transportability ingredient. Thickness of Alq3 was set to 30nm, and the vacuum

evaporation rate was carried out in 0.2nm/second.

[0295] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg film) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 9 by the example 39.

[0296] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 39 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry, it obtained the spectrum which has a luminescence peak near 635nm. The spectroscope which used the photodiode array by the Otsuka electronic company as the detector was used for spectrometry. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 2900 cd/m² was obtained by 8V.

[0297] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 1100 hours until brightness

was halved.

[0298] Example 40 this example is an example which produced the organic electroluminescence devices which used the amino styryl compound of above-mentioned structure-expression (15)-3 as an electron hole transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0299] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the vacuum evaporation system was set. The substrate was approached, the metal mask which has two or more 2.0mmx2.0mm unit openings as a vacuum evaporation mask has been arranged, and the amino styryl compound of above-mentioned structure-expression (15)-3 was formed as an electron hole transportation layer (*****) in thickness of 50nm under the vacuum of 10^{-4} or less Pa with vacuum evaporation technique. The vacuum evaporation rate was carried out in 0.1nm/second.

[0300] Furthermore, the bathocuproine of the above-mentioned structure expression was vapor-deposited in contact with the electron hole transportation layer as a hole blocking layer ingredient. The thickness of this hole blocking layer that consists of bathocuproine set to 15nm, and the vacuum evaporation rate was carried out in 0.1nm/second.

[0301] Furthermore, Alq3 (tris (eight quinolinol) aluminum) of the above-mentioned structure expression was vapor-deposited in contact with the hole blocking layer as an electron transport layer ingredient. Thickness of this electron transport layer that consists of Alq3 was also set to 50nm, and the vacuum evaporation rate was carried out in 0.2nm/second.

[0302] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg film) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 7 by the example 40.

[0303] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 40 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry, it obtained the spectrum which has a luminescence peak near 640nm. The spectroscopy which used the photodiode array by the Otsuka electronic company as the detector was used for spectrometry. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 3000 cd/m² was obtained by 8V.

[0304] After producing these organic electroluminescence devices, although it

was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 1100 hours until brightness was halved.

[0305] Example 41 this example is an example which produced the organic electroluminescence devices which used the amino styryl compound of above-mentioned structure-expression (15)-3 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0306] First, the 30mmx30mm glass substrate with which the anode plate which consists of ITO with a thickness of 100nm was formed on one front face into the vacuum evaporation system was set. The substrate was approached, the metal mask which has two or more 2.0mmx2.0mm unit openings as a vacuum evaporation mask has been arranged, and alpha-NPD of the following structure expression was formed in thickness of 30nm under the vacuum of 10^{-4} or less Pa with the vacuum deposition method. The vacuum evaporation rate was carried out in 0.1nm/second.

[0307] Furthermore, the compound of above-mentioned structure-expression (15)-3 was vapor-deposited in contact with the electron hole transportation layer.

The above-mentioned structure expression (15) Thickness of the electron transport layer (*****) which consists of a compound of -3 was also set to 30nm, and the vacuum evaporation rate was carried out in 0.2nm/second.

[0308] Furthermore, the bathocuproine of the above-mentioned structure expression was vapor-deposited in contact with the luminous layer as a hole blocking layer ingredient. The thickness of this hole blocking layer that consists of bathocuproine set to 15nm, and the vacuum evaporation rate was carried out in 0.1nm/second.

[0309] Furthermore, Alq3 of the above-mentioned structure expression was vapor-deposited in contact with the hole blocking layer as an electron transport layer ingredient. Thickness of this electron transport layer that consists of Alq3 was also set to 30nm, and the vacuum evaporation rate was carried out in 0.2nm/second.

[0310] The cascade screen of Mg and Ag was adopted as a cathode material, and by vacuum evaporation, this was also formed in the thickness of 50nm (Mg) and 150nm (Ag film) as vacuum evaporation rate 1nm/a second, and produced the **** organic electroluminescence devices shown in drawing 9 .

[0311] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 41 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like an example 40, it obtained the spectrum which has a luminescence peak near 640nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 3800 cd/m² was obtained by 8V.

[0312] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 1500 hours until brightness was halved.

[0313] Example 42 this example is an example which produced the organic electroluminescence devices which used the amino styryl compound of above-mentioned structure-expression (15)-2 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0314] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0315] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 42 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was orange, and as a result of performing spectrometry like an example 40, it obtained the spectrum which has a luminescence peak near 600nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1200 cd/m² was obtained by 8V.

[0316] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 800 hours until brightness was halved.

[0317] Example 43 this example is an example which produced the organic electroluminescence devices which made the amino styryl compound of above-mentioned structure-expression (15)-4 the electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0318] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0319] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 43 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like an example 40, it obtained the spectrum which has a luminescence peak near 620nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1100 cd/m² was obtained by 8V.

[0320] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 600 hours until brightness was halved.

[0321] Example 44 this example is an example which produced the organic electroluminescence devices which used the compound of above-mentioned structure-expression (15)-6 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0322] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0323] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 44 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was orange, and as a result of performing spectrometry

like an example 40, it obtained the spectrum which has a luminescence peak near 595nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 700 cd/m² was obtained by 8V.

[0324] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 300 hours until brightness was halved.

[0325] Example 45 this example is an example which produced the organic electroluminescence devices which used the amino styryl compound of above-mentioned structure-expression (15)-7 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0326] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0327] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 45 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like

an example 40, it obtained the spectrum which has a luminescence peak near 620nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 750 cd/m² was obtained by 8V.

[0328] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 450 hours until brightness was halved.

[0329] Example 46 this example is an example which produced the organic electroluminescence devices which used the amino styryl compound of above-mentioned structure-expression (15)-8 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0330] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0331] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 46 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like

an example 40, it obtained the spectrum which has a luminescence peak near 620nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 520 cd/m² was obtained by 8V.

[0332] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 250 hours until brightness was halved.

[0333] Example 47 this example is an example which produced the organic electroluminescence devices which used the amino styryl compound of above-mentioned structure-expression (15)-9 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0334] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0335] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 47 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like

an example 40, it obtained the spectrum which has a luminescence peak near 650nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1000 cd/m² was obtained by 8V.

[0336] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 600 hours until brightness was halved.

[0337] Example 48 this example is an example which produced the organic electroluminescence devices which used the amino styryl compound of above-mentioned structure-expression (15)-11 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0338] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0339] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 48 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was orange, and as a result of performing spectrometry

like an example 40, it obtained the spectrum which has a luminescence peak near 590nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1200 cd/m² was obtained by 8V.

[0340] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 850 hours until brightness was halved.

[0341] Example 49 this example is an example which produced the organic electroluminescence devices which used the amino styryl compound of above-mentioned structure-expression (15)-12 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0342] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0343] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 49 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like

an example 40, it obtained the spectrum which has a luminescence peak near 610nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 930 cd/m² was obtained by 8V.

[0344] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 700 hours until brightness was halved.

[0345] Example 50 this example is an example which produced the organic electroluminescence devices which used the amino styryl compound of above-mentioned structure-expression (17)-1 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0346] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0347] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 50 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated.

The luminescent color was red, and as a result of performing spectrometry like

an example 40, it obtained the spectrum which has a luminescence peak near 630nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1700 cd/m² was obtained by 8V.

[0348] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere mind, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 1000 hours until brightness was halved.

[0349] Example 51 this example is an example which produced the organic electroluminescence devices which used the compound of above-mentioned structure-expression (17)-2 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0350] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0351] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 51 under nitrogen-gas-atmosphere mind, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 40, it obtained the spectrum which has a luminescence peak near

655nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1400 cd/m² was obtained by 8V.

[0352] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 850 hours until brightness was halved.

[0353] Example 52 this example is an example which produced the organic electroluminescence devices which used the compound of above-mentioned structure-expression (17)-3 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0354] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0355] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 52 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 40, it obtained the spectrum which has a luminescence peak near 600nm. Moreover, when the electrical-potential-difference-measurement of

luminance was performed, the brightness of 900 cd/m² was obtained by 8V.

[0356] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 650 hours until brightness was halved.

[0357] Example 53 this example is an example which produced the organic electroluminescence devices which used the compound of above-mentioned structure-expression (17)-4 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0358] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0359] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 53 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 40, it obtained the spectrum which has a luminescence peak near 630nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1300 cd/m² was obtained by 8V.

[0360] After producing these organic electroluminescence devices, although it was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 750 hours until brightness was halved.

[0361] Example 54 this example is an example which produced the organic electroluminescence devices which used the compound of above-mentioned structure-expression (17)-5 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0362] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0363] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 54 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 40, it obtained the spectrum which has a luminescence peak near 660nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 800 cd/m² was obtained by 8V.

[0364] After producing these organic electroluminescence devices, although it

was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 500 hours until brightness was halved.

[0365] Example 55 this example is an example which produced the organic electroluminescence devices which used the amino styryl compound of above-mentioned structure-expression (15)-5 as an electronic transportability luminous layer among the amino styryl compounds of an above-mentioned general formula [I].

[0366] Layer structure and the forming-membranes method produced organic electroluminescence devices based on the example 41.

[0367] Thus, forward bias direct current voltage was applied to the organic electroluminescence devices of the produced example 55 under nitrogen-gas-atmosphere condition, and the luminescence property was evaluated. The luminescent color was red, and as a result of performing spectrometry like an example 40, it obtained the spectrum which has a luminescence peak near 660nm. Moreover, when the electrical-potential-difference-measurement of luminance was performed, the brightness of 1700 cd/m² was obtained by 8V.

[0368] After producing these organic electroluminescence devices, although it

was left for one month under nitrogen-gas-atmosphere condition, component degradation was not observed. Moreover, when energizing a current value uniformly, carrying out continuation luminescence and carrying out forcible degradation by initial brightness 200 cd/m², it was 900 hours until brightness was halved.

[0369]

[Function and Effect of the Invention] In the organic electroluminescence devices by which the organic layer which has a luminescence field is prepared between an anode plate and cathode according to the organic electroluminescence devices of this invention Since at least one sort of an amino styryl compound expressed with said general formula [I] to at least one layer of the configuration layers of said organic layer is independently contained as mixture A luminescence field can be constituted from an ingredient which can transmit energy to this specific amino styryl compound and/or this efficiently, and it excels in a high fluorescence yield at thermal stability, and red purity is good and can offer the red light emitting device of high brightness and high-reliability.

[0370] And by preparing said hole blocking layer, in the organic electroluminescence devices containing the above-mentioned amino styryl compound which has a quantum yield high originally, the hole in a luminous layer and electronic recombination can be promoted, and the organic

electroluminescence devices which present further high brightness and efficient luminescence can be offered.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the important section outline sectional view of the organic electroluminescence devices based on this invention.

[Drawing 2] It is the important section outline sectional view of other examples of **** organic electroluminescence devices.

[Drawing 3] It is the important section outline sectional view of other examples of **** organic electroluminescence devices.

[Drawing 4] It is the important section outline sectional view of other examples of **** organic electroluminescence devices.

[Drawing 5] It is the important section outline sectional view of other examples of **** organic electroluminescence devices.

[Drawing 6] It is the important section outline sectional view of other examples of **** organic electroluminescence devices.

[Drawing 7] It is the important section outline sectional view of other examples of

**** organic electroluminescence devices.

[Drawing 8] It is the important section outline sectional view of other examples of

**** organic electroluminescence devices.

[Drawing 9] It is the important section outline sectional view of the example of

further others of **** organic electroluminescence devices.

[Drawing 10] It is the block diagram of the full color flat-surface display using ****

organic electroluminescence devices.

[Description of Notations]

1 [-- 5 A protective coat, 5a,] -- A substrate, 2 -- A transparent electrode (anode plate), 3 -- Cathode, 4 five -- b -- an organic layer -- six -- an electron hole -- transportation -- a layer -- seven -- an electron transport layer -- eight -- a power source -- ten -- an electron hole -- transportation -- a layer -- 11 -- a luminous layer -- 12 -- an electron transport layer -- 14 -- a luminance signal -- a circuit -- 15 -- a control circuit -- 20 -- luminescence -- light -- 30 -- a hole -- blocking -- a layer -- A -- B -- C -- D -- A -- ' -- B -- ' -- C -- ' -- D -- ' -- organic electroluminescence devices